

Gyanu Raja Maharjan

Newar Indigenous Knowledge of Water Resources Management in Kirtipur

“Water, water, every where,
Nor any drop to drink.”

Gyanu Raja Maharjan

Indigenous Knowledge of Newar Water Resources Management in Kirtipur



Research Supervision, Editing and Preface by
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Preface

*N*ewar Indigenous Knowledge of Water Resources Management in Kirtipur by Gyanu Raja Maharjan is a comprehensive inventory of existing and extinct water resources in a historic city, Kirtipur as well as a unique Newar indigenous knowledge of managing water management system in the municipality. While exploring the water resources and its indigenous and local management system in his locality Kirtipur, the researcher and author has successfully achieved the goals of his research funded by National Foundation for Development of Indigenous Nationalities (NFDIN) during the fiscal year 2012-2013. This work to my mind is the first of its kind by the local for the local. It is so because Kirtipur is facing the problem of water scarcity day by day along with the advent of modern monster known as 'urbanization' and 'globalization'.

Day to day water scarcity is a global phenomenon beyond local. However, in Kirtipur's local case study, Gyanu's research reveals that the local and indigenous Newar people had very special beliefs, practices and knowledge to maintain water sustainably for life in the past and even today. Life of any kind without water does not exist. Therefore, there is no second planet like our Mother Earth feeding her billion children since life started on her lap.

Gyanu's work has painstakingly inventoried water resources, explored indigenous knowledge and suggested solutions of possible sustainability in water resources management which can be replicated in other cities and localities too. This work is a rare blend of accurate quantitative data and qualitative interpretation of the existing

scenario of water crisis due to uncontrolled and unplanned human encroachment in water resources and destruction of such resources. It is an essential reading for all sorts of readers and change their selfish nature and stop raping against mother nature. Human beings in modern days have become sinners or the Albatrous killer mariner as in *The Rime of Ancient Mariner* by killing one's own human sensibility and sensitivity on mother nature—as a result we have been facing the crisis,

"Water, water everywhere,
Nor any drop to drink."

○S T Coleridge

Unless we change our trecherous act on mother nature, one has to undergo its negative impacts like climate change caused by our own blunders.

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May, 2014

Gyanu Raja Maharjan
Kirtipur

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List of Abbreviations/Acronyms

AAN	Action Aid Nepal
ADB	Asian Development Bank
CBS	Central Bureau of Statistics
CDRD	Central Department of Rural Development
CHRDU	Central Human Resource Development Unit
CIUD	Centre For Integrated Urban Development
DB	Distribution Boxes
DDCs	District Development Committees
DWSS	Drinking Water Supply System
ESAs	External Support Agencies
FGD	Focus Group Discussion
Fig.	Figure
FY	Fiscal Year
GoN	Government of Nepal
HHs	Households
HMG	His Majesty Government
ICIMOD	International Center for Integrated Mountain Development
IDWSSD	International Drinking Water Supply and Sanitation Decade
INGOs	International Non-governmental Organizations
IUCN	Union for Conservation of Nature
km	Kilo meter
KUKL	Kathmandu Upatyaka Khanepani Limited
MHPP	Ministry of Housing and Physical Planning
MoF	Ministry of Finance
MoH	Ministry of Health
NeWaH	Nepal Water for Health
NFDIN	National Foundation for Indigenous Nationalities
NFE	Non-Formal Education
NG	Nepal Government
NGOFUWS	NGO Forum for Urban Water & Sanitation

NGOs	Non-governmental Organizations
NPC	National Planning Commission
NWSC	Nepal Water Supply Corporation
PRA	Participatory Rural Appraisal
RCUWM	Regional Centre on Urban Water Management
RRA	Rapid Rural Appraisal
RWSSFDB	Rural Water Supply and Sanitation Fund Development Board
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN HABITAT	United Nations Human Settlements Programme
UNICEF	United Nations International Cultural Educational Fund
VDC	Village Development Committees
WESS	Water and Environmental Sanitation Sector
WECS	Water Energy Commission Secretariat
WSSCs	Water Supply and Sanitation Committees
WSSUGs	Water Supply and Sanitation User Groups
WTO	World Trade Organizations

Introduction

1.1 Background

Indigenous people(s) play a significant role in the management and sustainability of water resources. Their knowledge is an integral part of humanity's heritage and cultural diversity. The relationship of indigenous communities to water resources permeates their culture and spiritual values. The people's relationship with water shapes their landscape as observed in the rice terraces structures and drainage systems. In many instances, indigenous people regard water not merely a necessity for human survival but a part of the people's spirituality as embedded in their myths and rituals. Water, to an indigenous person, is the essence of the spiritual and physical life, and the spiritual world is the source of all that sustains life. Water is also part of their dream time narratives and cosmological myths to explain the creation of the world and natural features of their environment. Indigenous knowledge system on water resource management is based on principles and practices that balance immediate needs and the needs of the environment, people, and other living things, as well as the sustainability of the needs of future generations.

Natural resources refer to any portion of the natural environment such as atmospheres, water, soil, forest, wildlife, land, minerals, and environmental assets. Likewise, goods and services supplied by our living or non-living environment to meet human needs and wants are the natural resources (Pradhan and Pradhan 2006).

Natural Resource Management (NRM) means appropriation, distribution, utilization, and conservation of natural resources and

the legitimate way of controlling them which integrates NRM into a framework for analyzing how people use natural resources to make a living. Actually, NRM has an important responsibility of enhancing the resources to the next generation with contemporary use, by which local people (users) can get maximum benefits and resources can also be quite protected and reproduced with various technologies that are available in local level (Upreti 2002).

On the other hand, NRM requires user's participation. Local people, who know resources very closely, are the real master of resources. Their participation will be more important for eco-balance. There are major two aspects in NRM—users' aspect and resources aspect. A balance, which is defined as NRM, between these two aspects is a way of environmental justice by which every element of ecosystem can get a proper chance to be protected and developed.

Nowadays, NRM is popularly being used as the means of poverty reduction with the proper use and management of resources, and poor people of developing countries like Nepal are benefiting well. Because of it, we can argue that poverty is the result of unequal distribution and unsystematic management of resources. It is obviously seemed that only those people, who exploit it, can preserve the natural resources themselves. It is argued that the participation of local people in the development of natural resource is considered as the best way to preserve, use, and management of it. People always want to exploit locally available resources to a maximum possibility by using various technologies and that is defined as development. When the local people get involved in resources exploitation and in management, then the developmental effort gets sustainability.

When the resources are utilized and managed in a proper way, then the country's economic power gets strengthened. There are huge amount of natural resources in various forms around the globe. In the same way, Nepal has also ample of natural resources and carries a lot of development potentialities but due to its wrong utilization and lack in management, it has remained a developing country. Nowadays, the natural resources have been utilized by the whole world in unmanageable way hence the world is facing several natural hazards

like climate change, global warming and ozone layer depletion etc which has directly affected the human beings and other living beings. Therefore, we always have to think of using natural resources in proper way so that it can last long in the future.

There are many varieties of resources available in nature. In this research only water resource is taken into account. Water is a mobile resource: it falls from the clouds, seeps into the soil, flows through aquifers, runs along stream courses, and eventually returns to the clouds via water bodies like sea, great lake etc. This natural cycle is the basis of all life forms and of the economy of humans. Water may be “managed” in different ways: it can be harvested, extracted from the ground, diverted, transported, and stored. This makes it different from all other natural resources. However, each form of management that interferes with the natural cycle exacts a price, not just in economic terms but in terms of environmental damage and greater health hazards. Moreover, water does not occur alone, it is rather part of a complex ecosystem consisting of the land, plants, aquatic and other life forms. The improper and unregulated use of water by humans will not only damage the water source but ecosystem as well. Thus, investment projects designed to enable users to have secure access to water will have to be examined from the standpoint of cost and economic benefit as well as in terms of their long-term impact on the environment. To be sustainable, water management schemes should respect the natural “logic” of water systems, and the ecology of which water is an important element.

Water exists in different forms, each of which may have multiple uses. There is surface water which appears to be stationary as in lakes and ponds, running water in the form of rivers and streams, and ground water in aquifers or mixed with the soil. But each form of water does not exist alone or independently of the others; on the contrary, they are all inter-connected through a complex natural process. A water system or water regime denotes the inter-connection among the different forms in a given geographical location. Individuals may make use of one water source or another (or a combination), depending on the nature of their livelihoods and their proxim-

ity to the sources of water.

Water is a common property resource and is critical for sustainable livelihoods. To begin with, all households need water for domestic use, i.e. for drinking, food preparation, washing, cleaning, etc. Access to adequate clean water will greatly contribute to improve health and better productivity. Secondly, there are distinct population groups whose livelihoods are water-based, entirely or to a considerable extent; such groups include fishermen, and artisans such as tanners and potters. Thirdly, water resources can play a significant role in improving food security and household income. Irrigation is the most common means of ensuring sustainable agriculture and coping with periods of inadequate rainfall and drought. Fourthly, water is employed to generate power for use in industry, services, and by urban/rural households. Finally, in the developed countries, water is an important asset for the leisure industry. The extent to which water resources contribute to sustainable livelihoods will depend on availability, the nature of rights of access, the system of management and the technology with which the resources are exploited. Moreover, the specific relationship between livelihoods and water resources will determine the nature of the stakeholders and their interest in the resources.

Our water resources, irregularly distributed in space and time, are under pressure due to major population change and increased demand all over the world. Access to reliable data on the availability, quality and quantity of water, and its variability, form the necessary foundation for sound management of water resources. The different options for augmentation expand the boundaries of the water resource in a conventional sense, helping to match demand and supply. All components of the hydrological cycle, and the influence of human activities on it, need to be understood and quantified to efficiently and sustainably develop and protect our water resources.

Water is an essential element for human survival and well-being and important to many sectors of our economy. However, resources are irregularly distributed in space and time, and they are under pres-

sure due to unwise human activity. Although water is available in abundant quantity, its distribution is uneven in terms of area coverage and time. Its supply in sufficient quantity particularly in densely settlement areas is now a growing problem in Nepal. There are number of such places in the hills and Tarai regions as well as in urban and rural areas where water scarcity is a burning problem.

Around the world, human activities and natural forces are reducing available water resources. Although public awareness of the need to better manage and protect water has risen over the last decade, economic criteria and political considerations still tend to drive water policy at all levels. Scientific best practices are rarely given adequate considerations.

Pressures on water resources are increasing mainly as a result of human activity—viz. uncontrolled urbanization, population growth, increased living standards, growing competitions for water, and pollution day by day. These are aggravated by climate change and variations in natural conditions.

Water is the largest natural resources of Nepal although only a relatively low percentage of the total population getting safe and clean water for daily use. Water is used for drinking, bathing, washing and cleaning. Besides, it is used in agriculture, industries, hydro-power generation, religious purpose and recreation such as swimming, fishing and different forms of eco-tourism. Water is a truly unique commodity. Without water life does not exist. Life can however, become uncertain even when there is water all around.

The world's water exists naturally in different forms and locations: in the air, on the surface, below the ground, and in the oceans. Freshwater accounts for only 2.5% of the Earth's water, and most of it is frozen in glaciers and icecaps. The remaining unfrozen fresh water is mainly found as groundwater, with only a small fraction present above ground or in the air. The precipitation process of water like rain, snow, dew etc plays the key role in renewing water resources and in defining local climatic conditions and biodiversity. Depending on the local conditions, precipitation may feed rivers and lakes, replenish groundwater, or return to the air by evaporation. Glaciers

store water as snow and ice, releasing varying amounts of water into local streams depending on the season. But many are shrinking as a result of climate change.

It is estimated that only about 3% water is potable in the world whilst Nepal has lavish portion on it. Its rugged topography creates great potential for putting these resources to economically productive uses, such as hydroelectric power generation and irrigation (Council 1993). There are about 6000 rivers and rivulets in Nepal out of which 100 are more than 10 km long. The total length of all the rivers and rivulets in Nepal exceeds 45000 km. Annual mean flow of Major River is estimate to be $4930 \text{ m}^3/\text{sec}$. This amount to 70% of total surface run off about 60-80 percent of surface runoff occurs during monsoon. In Nepal, the capacity of hydropower generation is 83000 megawatt but until now, it is only generation 600-mega watt i.e. 0.7% of the total potential (Lekhak and Lekhak 2003).

River basins are a useful “natural unit” for the management of water resources and many of them are shared by more than one country. The largest river basins include the Amazon and Congo Zaire basins. River flows can vary greatly from one season to the next and from one climatic region to another. Because lakes store large amounts of water, they can reduce seasonal differences in how much water flows in rivers and streams. Wetlands including swamps, bogs, marshes, and lagoons cover 6% of the worlds land surface and play a key role in local ecosystems and water resources. Many of them have been destroyed, but the remaining wetlands can still play an important role in preventing floods and promoting river flows.

Today, proper management and sustainable utilization of remaining water resources present in our surroundings is mandatory. It is an obvious fact that the indigenous people play a significant role in management and sustainability of water resources. The indigenous knowledge is a fundamental part of human heritage and cultural diversity as the relationship of indigenous communities to water resources permeates their culture and spiritual values. The indigenous people not only regard water merely a necessity for human survival but also as a part of the people’s spirituality as embedded in

their myths and rituals. It is the essence of the spiritual and physical life, and the spiritual world is the source of all that sustains life. Water is also part of their dreamtime narratives and cosmological myths to explain the creation of the world and natural features of their environment. Indigenous knowledge system on water resource management is based on principles and practices that balance immediate needs and the needs of the environment, people, and other living beings, as well as the sustainable fulfilment of the needs of the future generation.

1.2 Challenges

Basically, the concept of NRM is accepted as a balance between population and natural resources of a particular region. Because of its limited characteristics, natural resources and its balance with growing population are also being appeared obviously as a burning issue. The tremendous pressure on natural resource resulted in forest conservation, deforestation, habitat degradation, fragmentation, and socioeconomic complexities. As a result, some problems on resource management are being caused.

As a result of rapid increase in population, the access of people over natural resources is further weakening. The present scenario of increasing population and the declining of natural resources are merely producing conflicts in society and among the users. In the name of development the resources have been affected depressingly which cannot be defined as development in actual sense. Due to over exploitation, the natural resources are deteriorating day by day. A well planned and a wise use of the natural resources is urgent in current world in such a way that it can be handed over to the future generation.

There are different types of water resources in Kirtipur municipality but due to the lack of proper management, water scarcity is still a major problem throughout the year. Not only the cause of proper resources management, but there are lots of other causes like uncontrolled population growth, deforestation, urbanization, increased living standards, growing competition for water, and increased pollution day by day.

The water resources play a vital role in our daily life. Without water we cannot live and our livelihood activities cannot run smoothly as well as other kinds of works cannot be done properly. Nowadays, people do not have sufficient water for daily life activities. It creates a very big problem in our lives. The distribution system has failed because of the population pressure on the one hand and on the other is mismanagement where water is available. That means the difference between population distributions is changing in-between the decades in different locations in the municipality. But the drinking water supply is based on the age-old system, so some parts of the city have sufficient water whereas some do not.

Under the current trend of decentralization, local government is facing increasing responsibilities in a number of areas, including new roles relating to services delivery, development planning and environmental management in fulfilling its roles in each of these areas, water resources should be a key factor of consideration, as there will have impacts on local government's performance. Yet, local government is not at forefront of engaging with integrated water resource management.

Due to these challenges, the drinking water supply is not regular in Kirtipur. It is supplied only on alternative days by Kathmandu Upatyaka Khanepani Limited (KUKL) and somewhere it seems that once a week for half an hour or hardly for one hour. The people manage the use of water in their household activities from other water resources like dug well, well, river, Stone Spout, ponds, and Springs. But before one decade as a whole in Kirtipur municipality, there were very few tap water connections at households. At times people are using public water tap but nowadays there are thousands of water connections at home but the water crisis is increasing. Therefore, this research is also trying to identify the crises of water in Kirtipur municipality and tries to shed lights on the holistic approach of indigenous knowledge of water resources management considering all the social, cultural, spiritual, and economic factors in managing water resources.

1.3 Objectives

The overall objective of this research is spatial analysis of existing water resources and indigenous knowledge of water resources management in Kirtipur municipality and share the knowledge about water resource management for the sustainable local development.

The specific objectives are as follows:

- to reiterate the indigenous knowledge of water resources management,
- to find out the existing water resources, and
- to find out the utilization of water of the existing water resources.

1.4 Significance of the study

This research is closely related with water resources management planning by Indigenous people in Kirtipur municipality. It is a very useful technique of water resources establishment and management for the present as well as in the future also. It helps in managing the water crises problem as well as in local development. Furthermore, it balanced between natural resource management and increasing population as well as other sectors. This research has carried out the study of indigenous knowledge of water resources management of existing water resources in different location, their utilizations, quality and quantity, potential water resources, distribution and supply system, which may importantly contribute for local development, planning and management in the future. Different institutions have carried out research on the water resources management in Kirtipur municipality but no research has in detail been carried out about its planning for using indigenous knowledge. If it is studied on the indigenous knowledge and ideas about deteriorating water resource problem in Kirtipur municipality, our planners and policy makers will benefit for proper solutions and local development planning.

Similarly, this research will be helpful to the concerned institutions for water resources management, conservation, water supply, local development etc. Furthermore, this study tries to relate the re-

lationship of population growth and its impact on water resources. Therefore, it will be useful in the formulation and implementation of the plans and policies for the governmental as well as non-governmental organizations, planners, users' groups and communities.

Appraisal of Literature Available

2.1 Historical Concept

Thirty years ago, most of the academics working in the area of indigenous knowledge represented Anthropology, Development Sociology and Geography. Today, important contributions are also being made in the fields of Ecology, Social Science, Veterinary Medicine, Forestry, Human Health, Aquatic Science, Management, Botany, Zoology, Agronomy, Agricultural Economics, Rural Sociology—Fisheries, Information Science, Wild Life Management and Water Resource Management. It is a fact that contemporary research and advocacy of indigenous knowledge is founded upon the earlier pioneering writings of anthropologists like Conklin and Lewis (Ross and Pickering 2002).

The use of the term ‘indigenous’ began with Robert Chamber’s group at the Institute of Development Studies (IDS), University of Sussex in 1979. Others have written about indigenous technical knowledge (a special issue of the IDS Bulletin featured the term ‘Indigenous Technical Knowledge’) (ITK) which can be contrasted with modern scientific knowledge. Indigenous Knowledge (IK) is local knowledge – knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities and research institutions. It is the basis for local level decision making in agriculture, health care, education, natural resource management, and a host of other activities in rural communities. Such knowledge is passed down from generation to generation in many so-

cieties by word of mouth. IK has value not only for the culture but also for scientists and planners striving to improve conditions in rural localities (Warren 1991, 1992) of any part of the globe.

IK is an important natural resource that can facilitate the development process in cost-effective, participatory and sustainable way. The basic component of any country's knowledge system is its indigenous knowledge. It encompasses the skills, experiences and insights of people, applied to improve their livelihood. To ignore people's knowledge is almost to ensure failure in developmental (Brokensha 1980) efforts.

IK differs from scientific knowledge in that the former is a closed system while the later is an open system. Indigenous knowledge also differs from western knowledge in subject matter. It is concerned primarily with those activities that are intimately connected with the livelihood of people rather than with abstract ideas and philosophies. In contrast, western knowledge is distanced from the daily lives of the people and gives a more analytical and abstract representation of the world. Methodological differences do exist between both forms of knowledge. While science is open, systematic, objective and analytical, indigenous knowledge is closed, non-systematic and without any concepts. IK systems are embedded in social and cultural milieu of their particular community and scientific knowledge seeks to distinguish very clearly between these different dimensions (Agarwal 2003) of knowledge paradigms.

The basic component of any country's knowledge system is its indigenous knowledge. It encompasses the skills, experiences and insights of people, applied to improve their livelihood. To ignore people's knowledge is almost to ensure failure in development (Brokensha 1980). Since IK is essential to development, it is often suggested that it must be gathered and documented in a coherent and systematic fashion (Brokensha 1980, Warren 1995) for future reference.

According to working definitions of Martinez Cobo (Cited in UN 2009 Report), indigenous communities, peoples and nations are those which, having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, consider

themselves distinct from other sectors of the societies now prevailing on those territories, or parts of them. They form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions and legal system (United Nations, 2009) etc.

Indigenous peoples are peoples defined in international or national legislation as having a set of specific rights based on their historical ties to a particular territory, and their cultural or historical distinctiveness from other populations that are often politically dominant. The concept of indigenous peoples according to Wikipedia¹ is that these groups as particularly vulnerable to exploitation, marginalization and oppression by nation states that may still be formed from the colonizing populations, or by politically dominant ethnic groups.

Indigenous practices provide invaluable knowledge and aid in making best use of natural resources. In the modern days of technological advancement, this knowledge is often forgotten or neglected. In Nepal, negligible efforts have been undertaken in a systematic way to understand the scientific basis of this knowledge. It is recommended that the documentation of Indigenous Technical Knowledge (ITK) should be included in the curricula of environment and sustainable development as a cross-cutting issue. Water management is one of them.

Water is intrinsic component of human life right from birth to death. It has multiple values such as religious/spiritual, social, economic, aesthetic, medicinal and others. With the growing competition and conflicts over the multiple use of water, its management has been a crucial issue today. The infrastructure development alone cannot be sufficient for water management. Values, customs and rituals do have equally important role. Culture plays pivotal role which guides different value systems of our life and thus is indispensable part in management of scarce water. Sprinkling water brought from

¹ Wikipedia (2014) 'Indigenous Peoples', Wikimedia Foundation, Inc., September 2013.

holy rivers for purification and expiation is rife still in our culture. Different rituals such as *Shradhda* and *Tarpan* are performed nearby rivers and other water sources. Dipping in sacred rivers during certain planetary configurations has the potential of washing away past sins and accumulating religious merit. Long and arduous pilgrimages are undertaken just to take a dip in sacred rivers at those configurations (Sharma 1994).

The world's best-known human civilizations are based on water civilizations since they have been evolved at the bank of river, sea and other water sources. Thus, water management should be studied with the cultural perspective. Cultural practices, beliefs, customs, do's and don'ts and cosmic relationships are important factors to understand the philosophy and practices of water management resource in a given community (Sen et. al. 1997).

Water thus is one of the most important and precious natural resources and a regular and plentiful supply of clean water is essential for the survival of living organisms. Drinking water related to sanitation is widely studied in Nepal. The earlier studies concerned mainly in technical field and in providing the piped drinking water supply in the country. Majority of rural people obtain water from ponds, springs, rivers, stone spouts and wells. Various research works, have been conducted in the field of drinking water, irrigation, community managed, government managed water supply system, methods and techniques, and finding out their effectiveness but only a few research have been done about water resources management.

The richest continent in terms of total water supply is South America and Asia. Each has about 12% of the total land area of the world but receives about one-fourth of the total global runoff. Its 27% of the total runoff is shared by only 6% of the world populations. One of the richest countries in the world in terms of per capita water supply is Iceland, which has an annual renewable supply of 370,000n 3 (177 million gallon) per person. On the contrary, Kuwait and Bahrain have no renewable water supply. Egypt, despite the fact that the Nile River flows through it, has only 30 cu in per capita per annum on a renewable basis, 20,000 times less per person than Iceland.

Water use by humans has been increasing about twice as fast as population growth over the past century. The average amount of water withdrawn worldwide is about 646 cu (170,616 gal) per person/year. USA has the highest (5400 litre or 1400 gallon) per person per day as compared to 45 litre per person per day in less developed countries.

Uses of withdrawn water vary from region to region and country to country. Globally about 69% of the withdrawn water is used to irrigate 18% of the world's cropland (93% of the withdrawn water in India and 4% in Kuwait). Canada uses only 12% of the water for agriculture. Larger part (70-90%) of water used for irrigation goes waste due to evaporation and seeping. Seepage from the fields gets contaminated with fertilizers, pesticides and crop residues making it low quality.

About 23% of the water withdrawn worldwide is used for energy production (oil and gas production and power plant cooling) and industrial processing, cleaning and removal of wastes. Water withdrawn for energy production and industrial use is highest in Europe and North America, especially USA.

Domestic and municipal use accounts for about 8% of world-wide withdrawal and about 13-16% in industrial countries. Increase in domestic and municipal use and industrial use are usually accompanied by an increase in the wastewater. Along with the growth in population, urbanization and industrialization, volume of wastewater will increase enormously.

Chalise and Gurung (1993) have studied the natural resources management only in mountain environment at a broad regional scale of Hindukush Himalayan region. They discussed about forest, diversity, water, and land resources. They viewed and studied country-wise about the natural resources. Natural resources are available in all part of the country as well as the whole world. If the management of natural resources are studied in all part of the country then it will be very effective.

Gurung (1996) has studied the customary natural resources management systems of Tarami Magar community of the western hill of Nepal. He has concentrated his study on NRM with cultural ecology and political history. From the perspective of cultural ecol-

ogy, he has focused particular attention on local cultural systems and socio-political institutions and has asked whether they have served or can continue to serve as effective means for regulations of natural resources so that local communities can sustain their livelihoods. From the political and historical perspective, he has reconstructed historical process, both at the national and regional as well as the local level, and has examined their effects on the local system.

Qadri (2001) has studied about natural resource management with socio-political dimension as conflict management. In his study, he has not discussed only about the geographic agents and several natural resource management techniques, but also about the resources related conflicts and its resolution processes. His study was limited within five interconnected conflicts—two from irrigation system, one *guthi-land*, one spring water resource, and one from the forest pasture-land.

ICIMOD (2003) has located different infrastructure, resources in the study of GIS for the municipal planning of Kirtipur Municipality. The study has concentrated in dissemination of information with ward-wise distribution of water. In the case of water resources they are missing and have ignored small water resources. Thus, the planner has difficult to manage the water resources in Kirtipur through this study.

Traditional management of water resources in Bontok, the Philippines is based on the principles of communal/indigenous ownership and sharing, which takes into consideration the physical, social and spiritual aspects of man and nature. One of the people's traditional practices is readily observed during the dry season when water is scarcely enough to irrigate the rice/paddy fields. During summer, the Bontoks observe a customary law, traditionally known as the *oblis* in which the farmers take turns in watering their fields and observe communal/indigenous rituals known as the *manerwap* and *mangiyag*. The Bontoks also practise collective ownership of water springs and hence all members of the community are free to draw their drinking water from them. Moreover, traditional rituals are performed in water springs to appease or

give respect to the spirits dwelling therein and in return the spirits provide abundant and clean water for the people.

2.2 History of Water Supply in Nepal

The history of England is relevant here to talk about the development of water supply technique for the first time amongst households. After the 'Industrial Revolution', many private companies were established to provide drinking water in the cities of England, USA, Germany and France. In England, the private companies used to dig road and peoples had to put water pipes according to their own will but later those companies were made to take the permission from parliament. Those companies whose sole motive is profit, used to supply water to the rich families (Dixit and Upadhyaya 2005).

In 1800 AD, out of 1 million population of London, only one-fourth of families had their own private taps. The water used to be supplied to their houses thrice a week with one hour a day. Other families/people had to take water from the public taps. So the poor people got less priority there. The question of equity was raised there by such kind of unequal activities of private companies.

Since ancient times the people of Nepal have/had tried to manage water resources from rivers or streams for drinking. The history of water supply development in Nepal dates back to as early as the Lichhavi days when stone spouts, commonly known as *dhunge dhara* were constructed to fetch water near to the settlements. Constructed in the elaborated manner, some of these *dhunge dhara* have lasted until date for centuries. The first drinking water project inaugurated in 1891 BC, which was constructed under supervision of the English Engineers, came from Calcutta, was the first Drinking Water Project in Nepal.

Supply known as the *Bir Dhara* was the first modern water project. Water from *Madhav Khola* used to be collected in a tank made in Maharagunj. The water used to be supplied to places and houses of high standard officials was from that tank. At that time, many public taps were also established for locals. After four years, another *Bir Dhara* tap also had been built in Bhaktapur in 1895 BC. Dev Shamsar established many pure drinking taps in *Vikshya Pokhari* for

the public purpose, which was planned by his late wife, and he materialize her idea. He also made himself another tap in Bhimfedi later. He constructed another tap in memory of his dead son in 1921 BS. Prime Minister Chandra Shamser's first wife gave order to establish taps in her own native village Jajarkot in 1924 and at that time, another drinking water project was completed in Dhankuta. The Prime Minister Bhim Shamser made *Shree 3 Bhim Dhara* in Kathmandu in 1932 and Khadaga Shamser (the banished/expelled person from the nation) also established another water project in Tanshen, Palpa in 1930. Its resource was in *Bhulya Khola*, and another water project established in far western region Doti which was supervised from Indian side (Dixit and Upadhyaya 2005).

Nepal's most population used to suffer from water scarcity because the water available areas were located in remote areas. The water had to be fetched by females (even children as well); whereas males seldom fetched it. They had to wait many hours for water. Females' duty was childcare and they fetched water. Thus, the mothers and their children were deprived of education. Those people having taps nearby their houses could get the water easily but those who did not have they had to travel much more distance for fetching it. Mainly the women and children were engaged in water carrying chores.

Drinking Water and Sanitation Department opened up in urban areas only where the people's number was beyond 1500 and they were focused group. Local department donated the survey, design and money and counsellors of 'Design Section' constructed other function. Local people were deprived of repairing and sanitation problems. The sanitation department gave item instruments to repair and made them conscious about the Drinking Water project. However, in spite of these facts they were unable to go to the 'focused group' although large amount of money was spent on training but they could not get anything. Another department for the same effort was also built from the government side too. The local department was assisted by HELVATES and UNICEF and started to work for another new project. The project plan helped for training to local people about Health, Life, and Environment and their participation

in such programmes the people gained knowledge about the Drinking water project. The drinking water project was registered in 1989 and published instruction papers on water resources management and so on (ibid.).

So, one can claim that the modern water supply system in which water is delivered through pipes, began in 1985 AD in Nepal when the piped-water supply system was constructed by the then Prime Minister Bir Shamsar in the name of *Bir Dhara*. Sporadic works were carried out after that period in providing water supply services such as *Karma Kumari Dhara* (Amlekhganj), *Dhankuta Pani Adda* (Dhankuta), *Balnarsingh Dhara* (Pokhara), *Dhirdhara* (Biringanj), *Bhaktapur Pani Adda* (Bhaktapur), *Lalitpur Pani Adda* (Lalitpur), *Tri Bhim Dhara* (Kathmandu), Hoske (Kavre), Tansen (Palpa), and Khalanga (Jajarkot) by the Rana Regime in the past.

2.3 Drinking Water Supply and Sanitation in National Plans

Planned development in Nepal was initiated only in 1956 when the first five-year development plan for the country was launched. The planned development of water supply sub-sector was commenced with the advent of the Third Five Year plan (1965-70). However, the thrust in terms of institutional development, population coverage and increased level of investment came during International Drinking Water Supply and Sanitation Decade (IDWSSD, 1981-1990). The government gave an importance to optimum mobilization of non-governmental sectors, private sectors and public participation only from Eighth Five Year Plan. The Eighth Five Year Plan (1992-1997) set a target of 72% coverage for drinking water supply and 13% for sanitation to be achieved within the plan period. The evaluation report of Eighth Five Year Development Plan clearly mentioned that adequate authority has not been decentralized and sufficient financial authority has not been delegated to local agencies and user's communities.

The capability of users' groups and local agencies has not been strengthened and effective co-ordination yet to be maintained among these agencies. However, the government claims that the

population benefited by drinking water supply in the end of Ninth Plan 2001/02 was 71.6% and sanitation coverage was 27%. By the end of the Ninth Plan 71.6% of the total population has the access to drinking water. It was estimated that there are still 28.4% of the population deprived of drinking water facility, a basic need of life. The target of the Ninth Plan was to provide basic drinking water to all by the end of the plan period.

During the period, increased involvement of the consumers' group as well as wider public participation in the construction, operation and maintenance of drinking water projects created favourable atmosphere to make projects more sustainable. The sanitation programmes related to health, education and public awareness were also launched during the plan period. In Tenth Plan (2002-2006), it was taken strategy in rural drinking water project on the basis of community needs and demands the project undertaken, with the involvement of user community for maximum utilization of locally available resources and means. Moreover, it was given emphasis on the conservation of local resources and operating rural drinking water projects through the consumer committees and NGOs had also given emphasis (Tenth Plan, 2002-2007).

In Economic Survey 2006/07, community development is taken as the effort of government alone is not enough to expand the drinking water facilities, the policy of expanding drinking water facilities, through the involvement and partnership on the basis of their feasibility has been adopted. In order to ensure sustainability and certainty of projects and services, the concept of community management of rural and semi-urban projects were put forward to replace the concept of people's participation. Similarly, for ensuring and promoting the concept of community management, a provision of 20% contribution of the cost of execution of the project by the community has been made. However, in the case of backward classes and targeted groups of people, the policy seeks to contribute only 10% cost of the total costs to be borne by community has been adopted. Community based Drinking Water and Sanitation projects have been implemented in districts, which are lagging behind

in respect of availability of drinking water and sanitation facilities and Human Development Index. Similarly, some provisions have been made to set aside a fixed amount of budget in order to ensure realization of expected benefit for drinking water and sanitation facility and positive impact on public health and to develop health education program as an inseparable part of drinking water services. Facility extension programmes, aimed at promoting public awareness towards sanitation are in operation as an integral part of drinking water projects. Against the target to complete 13 projects under Small Town Drinking Water Projects under Development of water supply in the current Fiscal Year (FY) that would provide service to 123 thousand people, only 10 projects have been completed and the overall progress is recorded at 78% (Economic Survey 2007).

2.4 Ministerial Level and Policy upon the Water Supply and Sanitation Sector

Government of Nepal has made several policy interventions in the water supply and sanitation sector. As for the water supply sector, although some major works were carried out to provide services to prominent township like Pokhara, Dhangadi and Hetauda, it looks more than 16 years to establish a separate department to deal with water and waste-water services in the country. Department of Irrigation and Water supply which was established in 1966, was divided in two departments in 1972 as Department of Water Supply and Sanitation and Department of Irrigation. DWSS continued with its responsibility for larger systems, while Local Development Department with UNICEF assistance started a programme for Small rural water supply.

Until the Seventh Plan, all water supply programmes were run under the Department of Water and Nepal Drinking Water Corporation. The government gave an importance to optimum mobilization of Non-Governmental sector; private sector and public participation only from Eighth Five Year Plan. Ministry of Housing and Physical Planning (MHPP 1989) had reported on the existing situation of the water supply systems in some towns of Nepal. It has also highlighted

the needs and investment required for the water supply. It has pointed out several shortcomings and forwarded many proposals for reforms. These include needs for more water treatment plants upgrading the existing supply, networks and proposals for the control of contagious water borne disease (Pant 2002). The most active provider of the services in the Water and Environmental Sanitation (WES) sector are Department of Water Supply and Sewerage (DWSS), Local Authorities (DDCs and VDCs), External Support Agencies (ESAs), Non-Governmental Organization (NGOs) private sector, Community Based Organization (CBOs), and User Committees.

National Planning Commission (NPC) is responsible for the overall WES sector planning and coordination. It overlooks development plans and policies and approves annual budget estimates. Ministry of Finance (MoF) is responsible for mobilizing and allocating resources for the WES programmes. Ministry of Housing and Physical Planning (MHPP) is responsible for formulating the overall policies and looks after all rural water supply development and 22 urban water supplies. Nepal Water Supply Corporation (NWSC) also within MHPP, is an autonomous body responsible for water supply and sewerage in 13 urban centres in Nepal, including the Kathmandu valley.

Central Human Resource Development Unit (CHRDU) is mainly responsible for planning, coordinating, organizing and training activities in the WES sector. MLD is involved in providing water supply facilities through integrated rural development projects. Within MLD, the Women Development Division (WDD), and Remote Area Development Committee (RADC) are also providing a number of water supply and sanitation facilities. In addition, MLD also provides grants to DDCs and VDCs for the implementation of water and sanitation facilities (Pant 2002).

Ministry of Health (MoH) is mainly responsible for public health hygiene education and to some extent, promotion of on-line sanitation facilities. The Environmental and community Health Section under the Health Education, Information and Communication Centre of the Department of Health undertakes these activities. Ministry of

Education and Culture (MoEC) in the past provided health education through classroom lectures. It had also has a Non-formal Adult Education programme that included hygiene and health sectors.

Department of Water Supply and Sewerage (DWSS) established in 1972, is the lead agency for the drinking water supply and sanitation sector of Nepal. It is working towards achieving the sector objectives of the Government of Nepal which is to achieve sustained improvement in health status and productivity for the Nepalese people as a whole with particular emphasis on lower income group through the provision of adequate, locally sustainable water supply and sanitation facilities in association with improved personal, household and community hygiene behaviour.

The figure for coverage of population by mid July 2003 for drinking water supply was 71.6%. During the period mid July 2003 to mid July 2007, additional 2.62 million people have been provided access to supply of drinking water thus increasing the coverage figure to 80.4 % of the population. Out of this figure 1 million are covered by programmes implemented by DWSS and the rest by other agencies working in the sector. By basic sanitation the figure for coverage of population is about 46%.

These figures, however being through secondary sources, the task of having actual database on status had started from the fiscal year 2062/63 BS. This database, besides providing the real picture is in terms of actual coverage and overall sector status, will also help in identifying areas of urgent attention. Date report will be produced towards end of by 2064/65 (www.dwss.gov.np 2008).

The term 'water laws' refers to both municipal and international laws, norms, values and principles which project the right of people to access to water resources for various purposes. Generally speaking, water laws are rules enacted or provide by a legitimate authority that regulate the sector use of water. The search for principles of governing water resources are motivated by two basic concepts—

First, the Concept of Development Need: In order to ensure economic development by providing sufficient water for drinking, health and sanitation, irrigation, electricity and industry. Second, the

Concept of Pursuit of Justice: In order to ensure the equitable and reasonable allocation, distribution and utilization of water resources.

In this context, water law plays a principal role in:

- Protecting the right to water as a basic human right,
- Ensuring access to water for drinking, health and sanitation,
- Ensuring access to water for food/crops production,
- Meeting the water needs of industry and commerce,
- Resolving and preventing disputes over the allocation distribution and use of water resources,
- Facilitating the implementation of effective water policy, and
- Ensuring water quality by controlling pollution (Nepal 2005).

Additionally, the Government of Nepal has made several policy interventions in the water supply and sanitation sector. It has also introduced the water Resources Act 1992 (2049 BS, see Fig. 2.1). This is an umbrella Act, governing not only drinking water, but other uses of water and overall water resource management in Nepal. The Act prioritizes the right to use water for drinking purposes over any other domestic or commercial use.

There are two regulations under the Act for drinking water purposes—the Water Resource Regulation 1993 (2050 BS) and the Drinking Water Regulation 1998 (2055 BS). The Water Resource Acts have the following features—proper utilization of water resources, government ownership in all water resources, and guidelines and instructions for the use of water resources to minimize the negative impact on the environment.

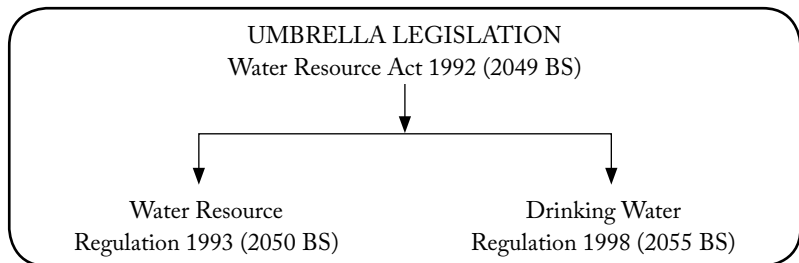
According to the Act, all Water User Committees should be registered with their respective District Administration to legalize their action. This act is the umbrella Act governing water resource management. It declares the order of priority of water use. The water resource vests ownership in the state. It provides for the formation of water users associations, established a system of licensing, and prohibits water pollution (Nepal 2005).

The Water Resource Regulation 1993 (2050 BS) is an umbrella regulation covering all uses of water and providing procedural mechanisms for the implementation of the Water Resource Act 1992 (2049 BS). The Regulation covers the formation of Water User Associations and District Water Resource Committees licensing provides a dispute settlement mechanism in relation to water use service charges, stress out the process to be followed by the State in relation to land acquisition and compensation and provides some forms in the schedules to the regulations for certain administrative procedures.

The Drinking Water Regulation 1998 (2055 BS) specially deals with drinking water sanitation as it affects drinking water. Among other things, this Regulation regulates DWUAs, the quality of drinking water and drinking water supplies.

Other major pieces of legislation governing drinking water are the Nepal Water Supply Corporation Act 1989 (2046 BS). This Act establishes the NWSC as a public corporation responsible for providing clean drinking water and sewerage services to the urban public. The scope of work of the Corporation has been determined by the formerly HMG by notification in the Gazette. This Act establishes the right(s) of people to drinking water and sanitation and imposes a duty on the State to provide drinking water and sanitation.

Figure 2.1: Water Resources Act and Regulations



Source: NPC, February 2005

Drinking water is also mentioned on by other legislation not necessarily specifically enacted for that purpose. The Local Self Governance Act 1999 (2055 BS), which primarily deals with the decentralization of government, also gives local bodies some responsibilities in relation to the utilization, conservation and management of water resources and the maintenance of sanitation facilities and waste management.

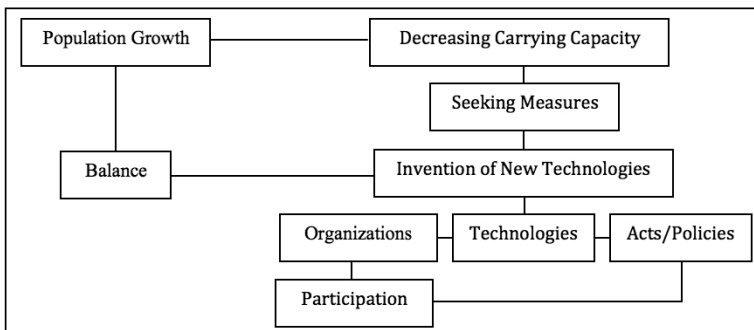
2.5 Natural Resource Management (NRM) Process

On the basis of ground reality and experience, I have myself developed the concept of NRM process in this study. I cannot though claim it as a concrete concept but it is forwarded to be discussed amongst the scholarly debates whether it can be claimed as a concept or not. In depth-discussion among the scholars can provide its final shape. Its origin point—I want to make is that the imbalance between population growth and natural resource. Although Gurung (1996: 2) has claimed that the population is not the major cause of imbalance and poverty, my argument is that the uncontrolled growth of population leads to all kinds of problems such as socio-economic, political, and historical etc. After such imbalance of decreasing carrying capacity, new measures of balance are sought. The effort of seeking discovers a new technology and finally the application of new technologies establishes a new balance.

NRM process is presented in fig. 2.2. The NRM process can be compared with Darwinian concept of 'Struggle for Existence.' Fundamentally, the struggle for existence in nature arises from different modes of change in organic and inorganic matter (Hawley 1950: 14). Human practices for establishing balance are its own struggle that developed out as process. The concept of balance, here is being compared with re-establishing the carrying capacity of natural resources. As applied to human population, the concept of balance concerns the ratio of numbers to the opportunities for living (ibid. 1950: 49). In this NRM process, the issue has arisen because of population growth. Immigration and natural increase play a crucial role in growing population of particular time and space. That increasing

population creates a high demand of resource and tries to consume to meet high level of satisfaction. Because of high consumption, environment starts to lose its carrying capacity. Gradually, the users notice an imbalance between the emerging population and the available resources and they start to seek some measures that help them to re-establish a balance. Their seeking effort may find or invent a new technology—organizational, people’s participation, acts and policies, and technologies—that help to meet their goal of establishing a new balance between natural resource and its users. It is assumed that the NRM system of the study area also passing through this process. Population of the study area also is increasing due to migration and natural increase and users are practicing to establish a balance.

Figure 2.2: Natural Resources Management Process



2.6 Community Managed Drinking Water Supply in Nepal

Besides governmental organizations, a wide range of some international and national non-governmental organization (NGOs and INGOs) are working on water and sanitation delivery services since 1990s. United Nations, World Bank, Asian Development Bank (ADB) have given emphasis in Community Managed Drinking Water. They are providing donations and aid in this sector.

Five Year Development plans have emphasized in the community drinking water. Sometime, they are giving conditional aid in the water sector. These agencies have still been making great attempts

to our benefit—regarding the drinking water related problems. In this regard the quote of *Washington Post*, June 1, 2004—“The World Bank today approved two separate projects aimed at poverty reduction through community-led and managed initiatives in Nepal. A US\$25.3 million credit was approved to extend the water supply and sanitation to over 800,000 people in rural areas of the country. A second US\$15 million grant was also approved to the Poverty Alleviation Fund (PAF), a pilot initiative created to bring increased opportunities for income generation and access to basic services and infrastructure to poor communities in rural areas”.

The *Post* further reports, “While the Government of Nepal struggles to provide effective support to marginalized groups, it also recognizes that some NGOs, community based organizations and donors have implemented a number of successful programmes to reach out to the marginalized groups, through community-managed infrastructure”, says Ken Ohashi, the World Bank’s Country Director for Nepal. It confirms that “...the government has wisely decided to turn the PAF over to those who know how to run it best and to scale up the provision of safe drinking water to the rural poor through mechanisms successfully demonstrated by the Rural Water Supply and Sanitation Fund Board.”

Poverty in Nepal is pervasive with about 40% of the population living below the poverty line. The poor live predominantly in rural areas and engage in subsistence agriculture on small plots of low quality land, have limited access to credit, infrastructure, markets, and basic social services, such as water and sanitation. Ethnic minorities and lower caste communities in remote areas, and women, especially female-headed households, lag seriously behind in terms of incomes, assets, and most human development indicators in Nepal (<http://go.worldbank.org/July 20, 2008>).

UNESCO in 2003 also mentioned about the Millennium Development Goal (MDG) for access to drinking water which was re-confirmed at world summit for sustainable development. It stated that the summit set the targets for access to sanitation, i.e. halving by 2015, the portion of people who do not have access to basic

sanitation. In the publication of UNDP in 1994 mentioned that in order to attain these goals, each country should immediately initiate engineering and feasibility studies on projects that considered to one of the highest priorities, and are based on a cost-effective technology appropriate to local conditions, with community participation, a good management and provision for operation and maintenance. ADB will continue to support community initiatives in small towns to develop water supply facilities to be maintained by local community or private enterprises. Private sectors management contract for urban water supply and sewerage services in the Kathmandu valley, under World Bank assistance in 2000 will be an important milestone for further processing for ADB assistance for the Melamchi Water Supply project (Bhattarai, 2006).

2.6. 1 Drinking Water and Sanitation in Interim Plan (2007/08-2009/10)

There has been a wide increase in the involvement and participation of the user's groups in the construction, operation and maintenance of water system. According to the Nepal Demographic and Health Survey (2006) nearly 90% households in urban areas and nearly 80% rural households have access to drinking water. In the same way, in the case of sanitation, about 37% in urban areas and about 20% in rural areas (households) have been using improved latrines, from the administrative records, about 77% of the people have access to drinking water and about 46% people use 16 proper latrines.

In the field of drinking water and sanitation, legitimization and coordination are deficient in the works of different agencies. In many places, necessary services have not been provided, in addition, adequate attention has not been paid to improve the quality of the available drinking water, and proper repair and maintenance of the constructed water supply system could not have been done. During this period an additional 400,000 of the population had the facility of drinking water and sanitation facilities were made available to 319,000 people of Nepal.

In FY 2002/03, the Local Infrastructure Development Policy was approved. According to this, works under seven sectors (rural roads, suspension bridge, small irrigation, community water supply and sanitation etc.) have been developed and conducted through local bodies. However, during this period, notable progress could not be achieved in the area of decentralization and devolution due to conflicts in the country and the absence of local representatives.

Population with access to improved drinking water is 77-85% in the tenth plan. In order to make the local bodies gradually responsible for basic water supply services, water supply and sanitation schemes serving less than 1000 people have been devolved to them. During the Tenth Plan period, drinking water schemes were implemented with due priority given to improvements in water quality and service standards. There has been a gradual increase in the participation of common masses and the involvement of the government and community based organizations for the development of water supply and sanitation services.

The process of transferring water supply management to the private sector has been initiated in the case of the Kathmandu Valley. Basic Drinking Water Service in Tenth Five Year plan was targets total benefited population was 22,680 (in '000) and the benefited population was 85%. But the achievement of benefited population was 20,434 (in '000) and 76.6 in percent.

The quantitative targets of the TYIP in the water supply and sanitation service coverage by the end of the TYIP period have been envisaged as mentioned below:

Indicators Status by 2006/07 TYIP Targets:

A) Basic Drinking Water Service

- Total Benefited Population (in '000): 24,327
- Percentage of Benefited in Total: 85

B) Medium and High Level Drinking Water Service

- Total Benefited Population (in '000): 4,293
- Percentage of Benefited to Total: 15

Strategies to attain the objective, during the TYIP period, will include the following:

- Execute simple technology based water supply schemes for extending the basic drinking water supply services.
- Ensure sustainable water supply services through rehabilitation and extension of previously executed old and damaged water supply schemes.
- Gradually improve the quality of drinking water in accordance with the Drinking Water Standards, 2007.
- Gradually extend the service standards as per the Water Supply and Sanitation Policy, 2004.
- Promote and extend sanitation facilities through public awareness at the rural and urban areas with the participation and contribution of the local government and Users' communities.
- Introduce necessary policy, institutional and legal reforms for adopting the Sector Wise Approach through effective coordination between the stakeholder agencies.
- Strengthen organizational capacity for effective and result-oriented plan implementation, monitoring and evaluation.
- Update and arrange for the dissemination of data and information on population with or without having access to water supply services.
- Priority will be accorded to complete the on-going drinking water schemes under construction within the three-year period through active participation of the users' groups.

New projects will be selected based on selection criteria that also evaluate the proportion of peoples' contribution, and priority will be accorded to the execution of those schemes that assure maximum number of peoples' participation. In order to ensure sustainable development and management of water supply and sanitation schemes, preparatory stage activities will be compulsorily undertaken prior to the commencement of construction works.

'Coordination Forums' for drinking water users' committees and forest users' committees will be established to strengthen the

financial management aspects as well as for conserving the sources of water. The responsibilities for operation, management and repair and maintenance of all the completed schemes will be handed over to the concerned users' committees. The policy regarding subsidy given for operation of the schemes handed over will be modified. The drinking water system (schemes) that are completed but presently not in operation due to lack of proper repair and maintenance will be rehabilitated for service delivery with the initiation and participation of the users' communities. Similarly, in the case of new schemes, provisions of Joint Investment Fund (JIF) and Advance Repair Maintenance Fund will be made mandatory (Nepal 2005) according to the interim plan.

There are many other related literatures to Community Drinking water, however they are not sufficient to provide such comprehensive information, which are related to comparison between community tap and public taps. Since this research is based on community oriented drinking water project of above-mentioned VDC, the literatures reviewed are empirically related to this area. They focused on other areas too such as health and sanitation, policy etc. It is found that most of the studies have limitations to explain about the level of local/indigenous people's participation. Even though all literatures related to this topic are valuable to generalize the condition of the whole country. At last our literatures conclude that community Managed Drinking Water is the best option to combat with water scarcity zone and sustainable drinking water management.

In this study, the local/indigenous people's participation in the use and management of natural resource has been discussed and been analyzed with the sustainable and participatory development approach. Equity, social and environmental justice are explored in the use and management system of natural resources through local people's participation with the decentralization approach. Involvements of all ethnic/indigenous and gender in the natural resources management are analyzed here with the participatory development approach that how many and which groups are participating in land and forest resources management. This study has mainly focused on

management system, including customary and modern technologies that are being practised in the study area is quite different from previous studies.

2.6.2 Nepal Water for Health (NeWaH)

Nepal Water for Health (NeWaH) is a national level non-governmental organization (NGO) that specializes in drinking water, health promotion and sanitation. Established in 1992, it has been working actively in partnership with local NGOs to serve poor communities secure basic services of water and sanitation, strengthening the capacity of these partners to undertake further development activities. It has an executive body comprising of 7 members and is affiliated with the Social Welfare Council—the governing body of I/NGO sector in Nepal and is registered with the District Administration Office.

NeWaH operates in selective districts of Nepal from the East to the Far West through its three regional offices located in three development regions (Eastern, Central and Mid Western region) of the country with the support of 93 professional regular staff. Each year NeWaH supports around 60 community based self-help water supply, health promotion and sanitation projects. The community receives financial, technical and capacity building support from NeWaH.

So far, NeWaH has worked in 50 districts of the country serving over 1 million people (estimated to be 3 percent of the national populations) through 1,013 projects working in partnership with 465 local partners (as of November 7, 2007). Social inclusion and equity is promoted all across NeWaH (both at programme and at organizational level) by adopting an approach of Gender and Social Inclusion (GSI) although most of its works are carried out in rural areas. It is gradually trying to extend the services for the rapidly expanding semi-urban poor areas.

NeWaH perceives itself as a 'Learning Organization' and continues to increase its focus on innovative and low cost alternative technologies, approaches as well as learning around water and sani-

tation such as Fog Water Collection, Rain Water Harvesting, Community Led Total Sanitation (CLTS), School Led Total Sanitation (SLTS), Integrated Water Resource Management etc. to contribute in improving sector's performance. Scaling up gender and poverty-sensitive community management of water supply and sanitation systems requires institutional commitment, resources, time and long-term support.

It has clearly demonstrated all of these over the past few years. What significant is that the NeWaH's ability to change institutional attitude in accepting and implementing approaches to enhance gender sensitive and pro-poor community management. It is essential to view women and men in a community as equal, regardless of caste or class, and to respond to their needs. This important dimension has been addressed in all stages of NeWaH's project cycle.

Addressing gender and poverty issues can substantially contribute to achieving equitable access and sustainability for poverty reduction. We can certainly look forward to these contributions in the next ten years with NeWaH's innovative and valuable work in the development of communities in Nepal. NeWaH conducts subjective researches at regular intervals to identify areas requiring improvement and for enhancing service standards and recommending on new, appropriate and alternative technologies and approaches.

In the recent years various studies such as the Water Consumption Study, Sustainability of Hygiene Behaviours, Long Term Sustainability Study, Public Latrine studies, NeWaH Participatory Assessment II, Socio-Economic Impact of WHS projects, etc have been carried out. These kinds of researches and studies have given basis for new learning, improvements and providing better services and will continue in the future, although Nepal is naturally bestowed with ample water resources only 82% of population has access to safe and clean drinking water.

Improved services such as piped-water and covered wells make up for almost 93% of water coverage in urban areas and 79% in rural areas (with 6.7% water piped to the house, 32.5 outside the house and 39.6% using covered wells). The remaining has to depend upon

the conventional sources like unsafe wells, lake, river, spring, etc. A UNICEF report in 2006, estimates that around 13,000 children die every year due to water related diseases before they reach their fifth birthday.

Thus, to support rural communities have access to safe drinking water NeWaH supports approximately 80 projects a year through all its regional offices. NeWaH 's water supply system mainly consists of Gravity flow and Tube well systems that serve communities with drinking water in the hills and Terai respectively (www.newah.org.np, 2008).

2.6.3 Rural Water Supply and Sanitation Fund Development Board

Rural Water Supply and Sanitation Fund Development Board (RWSSFDB) is promoting demand-driven community based approach in water supply and sanitation sector in Nepal by mobilizing non-governmental and private sector organizations in assisting communities to implement water supply and sanitation schemes. To increase ownership, sustainability, beneficiary communities represented by water supply and sanitation users' committees (WSUCs), implement schemes with the assistance of SOs. The community-based demand-driven approach to scheme identification, design, construction, operation, and maintenance moves the emphasis from the conventional supply driven development approach in order to increase beneficiaries' participation in decision-making, in implementing their decisions, and in sharing the benefits of the schemes.

The Board provides grant assistance to communities and SOs for the implementation of rural water supply and sanitation programs, which also integrates the following components:

- Community organization and mobilization,
- Non-formal education (NFE),
- Health, hygiene and sanitation education (HSE),
- Capacity building of SOs/SAs and communities,
- Environmental management,
- School sanitation program,

- Skill-based training,
- Women's technical support service linking to income generation,
- Micro-irrigation, and
- Other programs to support sustainable and cost-effective water supply and sanitation development.

On 14 March 1996, the government of Nepal created the Rural Water Supply and Sanitation Fund Development Board to promote sustainable and cost effective demand-led rural water supply and sanitation services in facilitation of Non-governmental and Private Organization to provide full emphasis on community ownership in conformity with the government's Eight Plan (1992-97), Ninth Plan (1997-2002) and Tenth Plan (2002-2007). Sector policies aimed at fundamental changes in the rural water supply and sanitation services delivery mechanism in the country. Ministry of Physical Planning works with the line ministry for the Board. It had completed its First Phase (1996-2003) successfully and entered in the Second Phase (2004- 2009) to support rural communities on implementation of water supply and sanitation schemes. The Board is being funded by World Bank and DFID (www.rwss.com, 2008).

2.6.4 Action Aid Nepal (AAN) in Community Managed Drinking Water

Action Aid Nepal has been implementing water projects in hilly rural areas of Nepal since 1984. Over the period, AAN has been learning from its experience and also from those of similar organizations involved in community development. Different approaches and policies have been adopted and the present approach has actually evolved from experience. From 1989, AAN changed its working procedures.

Some responsibilities of project implementation were given to the users. Project planning and prioritization were given by the AAN themselves. Community mobilization, site and store management mason and worker management, project implementation, and decision making once the project was started were taken up by the community. Maintenance fund collection was made compulsory.

Priority was given to training, meetings and workshop with users with the purpose of enabling them for qualitative outcomes from the implementation of the project. This helped slightly in improving ownership feeling among users, but was not satisfactory.

In the beginning, AAN had implemented projects directly at the request of the users. There was no assessment and prioritization system which involved the community. Even there was no thinking about the project sustainability. Therefore, the feeling of ownership among the users was lacking. As a result in the initial days AAN had to undertake the task of maintenance and repair itself.

After 1993 onwards, the main responsibility for project selection and implementation has given to users. AAN has providing budget and technical support only. The community has taken up material management decision-making and community mobilization responsibilities. Users are exposed and oriented to the market for the material purpose. Locally trained human resource is mobilized from the very beginning of the project implementation which has supported in confidence building in them. Priority has been given to users' awareness on health and sanitation, importance of DWS its sustainability, problem, source and environment protection, use of maintenance funds and so on. This has shown good signs on users' ownership (Bhattarai 2006).

2.7 Water Resource Strategy on Drinking Water

Strategic planning aims to improve one's current situation in order to attain a higher level goal within a given time frame. In the water sector, although strategic planning has been increasingly used as the national and sub-national levels, it has prevented to be a complex and time consuming process. Although considered highly desirable, few countries have been able to formulate an integrated national water resources strategy.

Despite the lengthy process, national water resources strategy formulation considered a necessary and worthwhile participatory process. It provides a systematic framework in which to develop and manage water that embodies all the varied facets of resources, and

to achieve a specified set of objectives over the long term. In the absence of such a framework, development has been an ad hoc and sub-sectoral because respective policies are often too general and slip into sub-sector biases.

Since conditions do change as change of time, water resources strategy must remain dynamic with updates typically required every five years. Creation of the initial strategy for development and management of Nepal's water resources is the biggest challenge. The decision to formulate a national water resources strategy was taken by former HMG/Nepal in 1995.

Despite its huge water resources potential, one third of population does not have access to safe water. In the past ten years, significant efforts have been made to improve access to water supply and these efforts need to continue if full coverage is to be achieved. Although data are not well documented, regarding private sector and community contributions to capital investment and operating costs, there is clearly an increasing shift away from reliance on the public sector. Overall in the water sector, capital investments from the private sector and communities have reportedly been low. Domestic Water supply and sanitation coverage for rural water supply has increased steadily because investment requirements are low; however, imperfect sustainability of schemes may erode some of the gains. If sustainability is maintained, full coverage for rural water supply is feasible in the next 10 to 15 years (WECS 2002).

Given the enormity of the challenges of environmentally sustainable development, it is recognized that significant progress can only be made with a high level of community participation and ownership. Achieving this goal will require increasing awareness through the delivery of education programmes these will in turn lay the basis for communities to take the initiative for watershed management and protection of aquatic ecosystems. In this way, government agencies will simply facilitate the process through the provision of technical advice and channelling of government funding.

In addition, for water resource projects, communities should be made partners in the development to ensure that environmental and

social impacts are properly identified and mitigated. In fact, many projects can support programmes to enhance environmental and social benefits, if coordinated and designed with consideration for the needs to the surrounding communities (WECS 2002).

Drinking water is a basic human need. Every Nepalese should have reasonable access to potable water. In addition, since provision of adequate potable water is not enough by itself to ensure better health conditions, there should be widespread education regarding hygiene and access to appropriate sanitation facilities. In the strategy adopted by former HMG is by the end of 25 years, all people will be benefiting from adequate water supply and sanitation with related health improvements.

Former HMG had initially targeted 2001/2002 as the date by which reasonable access to safe water would be provided to the entire population; this goal could be achieved so quickly. The Water Resources Strategy has adopted the following targets for water supply and sanitation (Table 2.1).

Table 2.1: Targets for Water Supply and Sanitation

Year	Access to Safe Water Supply		Provision of Safe Sanitation
	Basic Services	Good Services	
2007	85%	40%	60%
2012	100%	60%	80%
2017	100%	85%	100%
2027	100%	100%	100%

Source: WECS, 2002

The main focus of Water Resources Strategy will be to provide basic levels of coverage to all rural areas as quickly as possible. Thereafter, the emphasis will shift to improving the level of services. Good progress has been made since the past ten years, but one-third of rural people still lack even basic water supply services and the vast majority lack basic sanitation. Another concern is to ensure that the

communities can maintain water supply schemes otherwise coverage could eventually decline. The strategy will be to—

- Support and strengthen CBOs and WUSCs,
- Maintain and coordinate rural water supply development programmes,
- Promote/support good sanitation and hygiene awareness, and
- Support and strengthen DWSS as a core government organization.

In rural areas of Nepal, villages are small and housing is often scattered. Accordingly, rural water supply schemes tend to be quite small and aim to provide water at collection points that are no further than 250 m from the beneficiaries. CBOs and/or communities selected by beneficiary groups constitute the best method of implementing and managing those schemes. Nepal will continue to vigorously endorse this approach and will provide support to strengthen CBOs and WUSCs in areas where new water supply schemes are planned (WECS 2002).

2.8 Stone spouts and Source Conservation for Water Usage Declarations-2007

1. The ownership of traditional water sources including stone spouts is given to local authorities.
2. The policy lacking in the field of stone-spouts and source conservation will be addressed by the Government of Nepal.
3. Local authorities will take the responsibilities of preparing maps of stone-spout system from source to sink along with cadastral mapping.
4. Historical stone-spouts will be declared as national heritage.
5. Conserve water sources and water paths passing through private land. For the conservation of watersheds and aquifers government will declare the area as watershed area.
6. Annual budget will be allocated for stone spouts and source conservation.

7. The municipalities will organize local communities including women into formal users groups and strengthen them for the conservation of stone spouts and sources.
8. Promote and celebrate *Sithinakha* festival as the national festival of sanitation and organize programmes of traditional water source conservation on that day.
9. Promote studies on stone-spouts, conduct researches and incorporate the subject in various levels of curricula.
10. Promulgation of acts to control unauthorized use of ground water that hampers the stone-spout system.
11. Set concrete programmes on stone-spouts and source conservation by national and international non-governmental organisations.
12. Adopt concrete policies, programmes and resources for the conservation of stone spouts and their sources by local and central government.

The workshop also identified some key actions for effective implementation of the declarations as—

1. Publicize traditional stone-spouts as national heritage as per the Ancient Monument Conservation Act, 2013.
2. Sensitize Department of Land Revenue and Department of Survey about the declarations and work with them in conservation efforts while considering the Ancient Monument Conservation Act, 2013.
 - Traditional Stone spouts Enumeration and Mapping, NGOFUWS 2009
 - Second Annual Report, KUKL 2009
 - Situation of Traditional Water Spouts in Kathmandu Valley, ICON/UNESCO/
 - RCUWM 2008
 - Water Movements in Patan with Reference to Traditional Stone Spouts, UN HABITAT 2008
3. Promulgate separate Act for conservation of traditional stone spouts and their sources.
4. Research to prepare complete map of the stone spout sys-

- tem identifying aquifer, source area, and water paths.
5. Define protected zones in watershed, aquifers and water paths of the stone spouts prohibiting any kind of construction.
6. Include lessons on stone spouts and traditional water sources in school curricula.
7. Monitor allocation of annual budget and establish necessary trust for stone spouts and source conservation in municipalities.
8. Organize awareness programmes and advocacy campaigns.
9. Celebrate *Sithinakha* as the National Sanitation and Water Conservation Day.

Methodology

3.1 Sources of Data and Information

Spatial analysis of all the existing water sources (well, dug well, Stone Spout, pond, and river) in Kirtipur municipality were collected through Geographic Information System (GIS). Their locations were verified by GPS on the toposheet (1:25,000) and satellite image. Other information were compiled and analyzed in different tabular forms using Excel and SPSS computer software. The digital information of geographic data was prepared by digital maps published by government of Nepal. For this purpose, Arc-GIS software was used throughout the study.

The water quality, quantity, demand, utilization of existing water and indigenous knowledge of water resources management had observed in the field work by check list survey, key informants' survey and pass observation by researcher.

The present study has used both the primary and secondary sources of data. Primary data were collected through the individual questionnaire and key informants interview questionnaire (Annex III) with the water consumers. Besides, relevant information of the water resources management were elicited from the study area.

3.2 Methods of Data Collection

3.2.1 Primary Data

All the primary data have been collected from field through the

method of observation using structured field protocol and data sheet besides the use of GPS and maps, for collecting data related to geographic position. At least one photograph of all the existing water resources (a total of 90 see Annex IV, Photos of some reservoirs are not included) and also other information has been taken. Being constrained by time and resource limitations, for collection of field data the monsoon season (July-October) had been preferred since the year to year fluctuations in discharge rate of the resources. I had visited each ward to build the rapport for this research work. I had enquired the informant's leisure time and working time at their houses or in the shops and gathering places. This helped to prepare schedules for interview. The primary information of this study was drawn from key informants' interviews, informal discussions using checklist, and group discussion (Annex III) at the local level.

3.2.2 Secondary Data

The collection of data started with the study of related literatures and other secondary sources of information. Relevant information was also collected through different government and Non-government offices, Institutions, ICIMOD, Development Agencies and Libraries. Secondary information was collected from the KUKL Kirtipur Branch. The digital data of Kirtipur municipality was taken from GENESIS Consultancy Pvt. Ltd. and Survey Department. Google was the important search engine source used to find out additional literatures related to the Water resources management and their facts. Moreover, related books, journals, articles and newspapers have been used as secondary source of data.

3.2.3 Field Study

a) Observation

In the context of Newar indigenous knowledge of water resources management in Kirtipur, I had reviewed the very beginning observation and reminding these traditional technology and discussed with the old aged people in local/indigenous community about the technology. Observation (Annex I) means viewing or see-

ing. In this part, I had collected data by direct observation of the water resources and ask to the people who are using water. The researcher engaged in observation from the very first day of my field visit until the completion of data collection. Basically, this technique was used to observe utilization of water resources by the peoples in their daily life. In that time, the condition of the resources, locations, surroundings, water conditions were observed.

b) Focus Group Discussion

The qualitative information necessary for the present research were collected through the focus group discussion with the Newar indigenous people. The main purpose of the discussion was to obtain more detailed information about the Newar indigenous knowledge, management and situation of the water resources; especially management of resources, institutional role, factors responsible for water crisis. To conduct different focus group discussions, I had organized group discussion of people in several wards. The effort was made to involve water users groups (Annex II) of people. The result of focus group discussion was noted and analyzed for the findings of this study.

c) Key Informant Interview

Old-aged Newar indigenous people from several wards having information about the past activities of the water resources, were key informants of this study. They are knowledgeable persons about the sources of drinking water, management, utilization and so on. Their knowledge was also used as a field instrument in this research. It was used to gain overview of the local perception regarding water resources management. The information related to historical overview, utilization, management and establishment of water resources was also discussed. The other benefit was to provide a chance of cross checking information collected from different water users' groups through different methods. Altogether ten persons from different wards were interviewed during the field work. A key informant in this research was chosen on the basis of particular knowledge s/he

had about water related problems. Other informants include previous researchers and different related institution's staff as well.

3.3. Sources of Archived data

Almost all of the data related to the study have been collected primarily from the field itself meanwhile the following archived data have also been used for the study.

- i. Topographic maps Sheet No. 2785 06A with the scale of 1:25000 prepared by Survey Department (HMG and FINIDA, 1995),
- ii. Satellite Image 1 metre resolution of Kirtipur extracted by Google,
- iii. Various Research Reports, Journals and Documents, and
- iv. GIS digital data of Contours, Ward boundaries, road and river networks in Kirtipur Municipality (Map 4.2 p. 58) from Central Department of Geography.

3.4 Data Processing and Analysis

The primary data collected from the field work are processed using MS Excel and Arc-GIS software. The raw data are classified and assigned value according to the data classification which has been prepared on the basis of their information from questionnaires. Quantitative data were processed by using statistical package SPSS and EXCEL. These packages were used to generate tables, simple statistical calculation as well as diagrams. Classified data were stored in the table formats showing related data together. Further processing such as calculation of total, types, quantities were done in the Excess itself using formulae. The summarized and composite value tables of the each component were converted to the database file in EXCEL format.

The information gathered from different sources and methods were subsequently edited, processed and analyzed. As data were both qualitative and quantitative in nature, separate methods and techniques were applied to analyze data and to make meaningful conclusion.

3.5 GIS Mapping

Presentations of data by map are done by using Arc-GIS in the following manner—

- The GIS data of wards boundary, road networks, river system and contours of Kirtipur municipality are achieved in Arc-GIS.
- From the overall water resources only the required objects are identified and saved as new themes.
- A total of 85 different existing water resources are located by the GPS.
- Separate views are created for each category that has to be represented by map with related themes and also the corresponding database files created from EXCEL are added and linked with.
- The related attribute data are classified and the classes are represented in the map using graduated and unique symbols or colours.
- The GIS mapping techniques are thus used to exact location of the water resources in the maps.

3.6 Limitations

This study covers all parts of the Kirtipur municipality, where the water resources exist. Although some destroyed or extinct water resources were not visible in the field study, have been covered through the local people's information. I had tried to collect the water users' information of different resource locations during my field work. Some additional aspects like health problems, social conflicts, and economic aspects have been included in this study from individual questionnaire and conversations in the field work. While in observation, resources management, condition, types, location, spring size, area etc had been observed for its analytical conclusions.

A Description of Study Area

4.1 Physical Setting

Nepal is a country made up of villages with unparalleled natural beauty and cultural diversity. Rural areas can be depicted as a real face of Nepal since it preserves its own culture, languages, life style, values, livelihood, traditions, institutions and natural resources. The number of people living in 3915 Village Development Committees (VDCs) exceeds 86% of the total population in the country. Farming is the major economic activities of the people living in rural areas where others non-farming activities are rare.

Similarly, Nepal is a landlocked Himalayan country, where one can find different Himalayas, as well as rivers, forest and much more natural resources. So one can claim that Nepal is rich in natural resources. Ecologically Nepal has divided into three broad regions such as Mountain, Hill and Terai where no uniform distributions of natural resources are found in these regions. Water resources are most available in mountain region, forest, and horticulture is found in Hill region and agriculture suitability in the Terai region.

Kirtipur (Maps 4.1 p. 53 and 4.2 p. 58) is an ancient and historical Newar dominant settlement situated on a double hill rock in the southwest of the Kathmandu Valley and it is one of the five municipalities in the valley. It is located at 27°38'37" to 27°41'36"N and 85°14'64" to 85°18'00"E and at present has 19 wards and covers 1801.35 ha (18.01 sq. km). It is bordered with the Bagmati River to

the east, Machhengaun VDC to the west, Kathmandu Metropolitan City (KMC) to the north, and Chalnakhel VDC to the south.

It was identified as a 'town' or urban locality in the 1952/54 and 1961 census of Nepal. It was declassified as a town in the 1971 census when the criteria for designing urban localities were changed. Kirtipur Municipality was formed in 1997 by combining eight VDCs, namely Palifal, Layaku, Bahirigaun, Chithubihar, Champadevi, Bishnudevi, Balkumari, and Chobhar. The total population of these VDCs in the 1991 census was 31,338 (ICIMOD 2003). The 2011 census has recorded a total population of 65,602 representing 55.6% male and 44.4% female 19,441 households, average household is 3.37 and equivalent to an overall average population density in the municipality of 36.4 persons per hector (CBS 2011).

There are several types of water resources available in Kirtipur such as river, rivulet, lake, well, dug well, Stone Spout, pond, and spring in different locations. The utilization of the resources is for different purposes. Before the establishment of the Kirtipur municipality, the core Kirtipur area has four VDCs and Kirtipur has boundary wall around the whole area and 12 outlet big door (*Dhokas*). There are about 7 big ponds outside the wall all over Kirtipur. These pond's water have been used for drinking, irrigation and other purposes.

The source of water was taken from the *Dhud Pokhari* from the south to the pond connected through the canal name *Raj Kulo*. The main sources of *Dhud Pokhari* is located in a high altitude than the pond so that without pumping the water, it fills into the pond. These ponds have been historical evidence with Prithivi Narayan Shah's brutal attack in Kirtipur. When Prithivi Narayan Shah had attacked Kirtipur 3rd time, his force had closed all the 12 big doors of Kirtipur and blocked the drinking water sources for people and the people had to surrender and only finally Prithivi Narayan Shah's brutality campaign was over in Kirtipur. Nowadays one can find only 3 ponds remaining out of 7 in and outside the Kirtipur ring road. Unfortunately, all the ponds were destroyed or extinct and build public space, public buildings and private houses were built.

4.2 Change and Development

Being a new municipality with a comparatively low population density, the problems of unplanned growth are not yet severe; however, such problems of water scarcity have started emerging acutely. A study conducted by the Kirtipur Environmental Mapping Project (conducted by the National Society for Earthquake Technology (NSET) with the support of the USAID Urban Environment Programme in 2000) has identified solid-waste management, river water pollution, and air pollution as growing problems (NSET 2000). The report has emphasized on the need of adequate financial resources and technical manpower to deal with the environmental problems like dumping of solid waste in and around settlement areas, historical ponds, and heritage sites; direct discharge of sewage and untreated industrial waste into surface water drainage systems; air pollution resulting from industries and unpaved roads, among others; poor maintenance of temples, shrines and historical structures.

Services such as solid-waste management, drinking-water supply, and roads need the immediate attention of planners. Despite having panoramic views of the Kathmandu valley and the mountains beyond, this historic, linguistic and culturally significant town has not been able to promote itself as a quality tourist destination. Instead, with its poor infrastructure and preponderance of low-income families in the core area, it is seen by tourists as an example of picturesque poverty. It is imperative that the development activities of the municipality are managed and coordinated before the situation becomes worse (ICIMOD 2004).

4.3 Socio-Economic Setting

4.3.1 Social Setting

Literacy Status

There are 50 educational institutions within this municipality. Among them location of the Tribhuvan University indicates the higher educational facility to the local people. Of the total population

6 years of age (over 37,418 in Kirtipur municipality) 73.5% is literate. Male literacy is 85.9% and female 59.4%. Compared to national average, the overall literacy is higher (national average 53.7%).

Educational Attainment

Among the total literate population (52,482) in the municipality only 24.9% has attained Primary education, 16.4% Lower Secondary and 13.7% Secondary education. Literacy of SLC constitutes 12.5%. The proportion attaining higher education i.e., beyond SLC is 22%.

Health and Sanitation

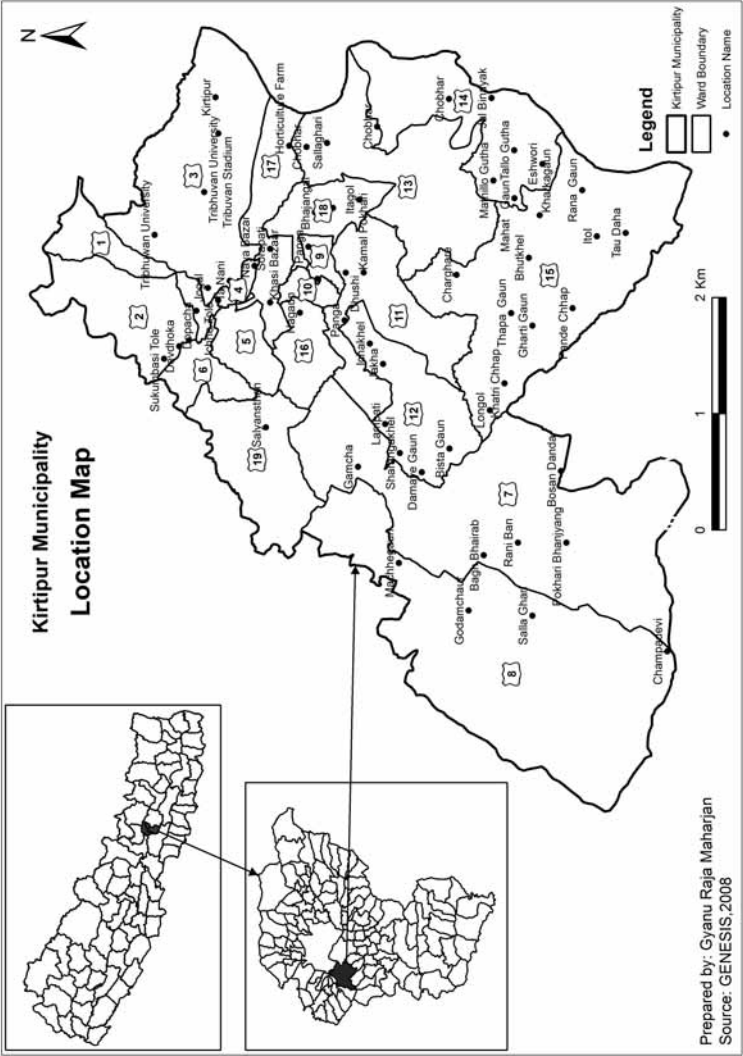
There are only 1 small hospital, 1 health posts, 8 sub-health posts and 31 health clinics. The basic facility is not available to more than half of the wards. In the case of emergency the local inhabitants have to rush either to Kathmandu or Patan hospitals. Establishment of district level hospital or more health centres is the urgent need for the current population of 65,603. However, the municipality has provision for ambulance service for emergency or general patients to take them to the hospitals in Kathmandu and Lalitpur cities.

Almost 68% households have modern flush toilet and about 25% households are using ordinary toilet in the municipality. On the contrary, about 7% of the total households in the municipality use open toilet and the rest of the 1% does not state about its toilet facility. Proportions of households using modern toilet in ward No. 2, 7, and 13 are significantly higher than the proportions of households using ordinary toilet as well as open toilet. The proportions of household using ordinary toilet facility vary in different wards, which ranges from 2% in ward No. 10 to 67% in ward No. 19. The proportion of households using open toilet ranges from 0% in ward No. 19 to 20% in ward No. 7 as the highest.

Market Places

Markets are mainly concentrated in the core area and less in its peripheries. The major local inhabitants of this area are farmers. Kathmandu is near and relatively easy from Kirtipur to reach for agricultural products selling. As a result, the vegetable market covers

Map 4.1 Location Map of Kirtipur Municipality



36% of the total Kathmandu market. One can get larger number of not so specialized shops such as mixed shop of vegetable, meat, fruits, and fish etc. According to the observation there are more than 50% non-agriculture based shops.

Public Institutions

It includes banks, co-operatives, post office, ward office, governmental and semi-governmental organizations etc. There are 75 public institutions within the area. Besides ward offices, most of the public institutions are located at the core area.

Heritage Sites

Kirtipur is one of the oldest cities of the Kathmandu valley. One can find a number of traditional and cultural structures such as *Pati* (rest places), Temples, *Bahal* (courtyards), Stupa, *Sattal*, Cave, and Lake. Around 80% of which is scattered in old core area of the city, Panga and Chobhar areas.

Caste and Ethnic Composition

There are many caste and indigenous (ethnic) groups in the municipality. Among them Newar comprise (55.6%), Chhetri (19.0%) and hill-Brahmin (12.6%), Tamang (3.6 percent) and Magar (1.9 percent) including other caste and indigenous (ethnic) groups with less than 1% population in the municipality comprise of Sarki, Rai, Gurung, Damai/Dholi, Sherpa, Tharu, Yadav, Kami etc.

4.3.2 Economic Setting

Economic condition plays the most dominant role for survival. So, everyone is trying to maintain his/her good economic condition and living standards. Different economic settings are established in different parts of Kirtipur as mentioned below.

Occupational Structure

Traditionally agriculture was (and still is) the main economic activity of the people of Kirtipur. But this activity has significantly been reduced with acquisition of land for Tribhuvan University and

Horticulture Research Centre during the 1950s. Kirtipur now has relatively low percentage of families entirely engaged in agriculture. Agriculture, small-scale cottage industries and crafts still dominate the occupational structure of the town (Shrestha 1991).

Agriculture

Most of the households use land for agriculture purpose. It is interesting to see that the municipal households with land use for agricultural purpose (49%) are slightly lesser than the household with no land use for agricultural purpose. Most of the wards have relatively lesser the proportion of the land use for agricultural purpose, however some wards i.e., 7, 8, 10, 12 and 15 consist about 45% of the land use for agricultural purpose (MUAN 2006) here.

Factory/Industries

At present Kirtipur has five national level industries. A few big factories like the Sitaram Gokul Milk and Pasma Factory are established here. Apart from big industries, there are around eighty other smaller industries. Predominantly among them are carpet factories. Fifty different scales of these factories like cottage industries, handmade paper, woollen crafts, and notebook factory etc are mostly concentrated in old core and Panga areas. Ward No. 3 and 17 have the greatest number of industries.

Small Scale Economic Activities

Small scale economic activities also support to the livelihood of the people. The people are involved in different small scale economic activities. Some households have small scale economic activities, whereas more than 87% of the households have no economic activities in the municipality. Only about 7% of the total households have adopted business and about 3% have services. Other activities are very less. The figure shows that most of the business activities are concentrated in ward No. 3, 5 and 17 which consist about 42% whereas people with official services concentrate in ward No. 17 which is about 17% of the total households of this municipality.

4.4 Population Distribution

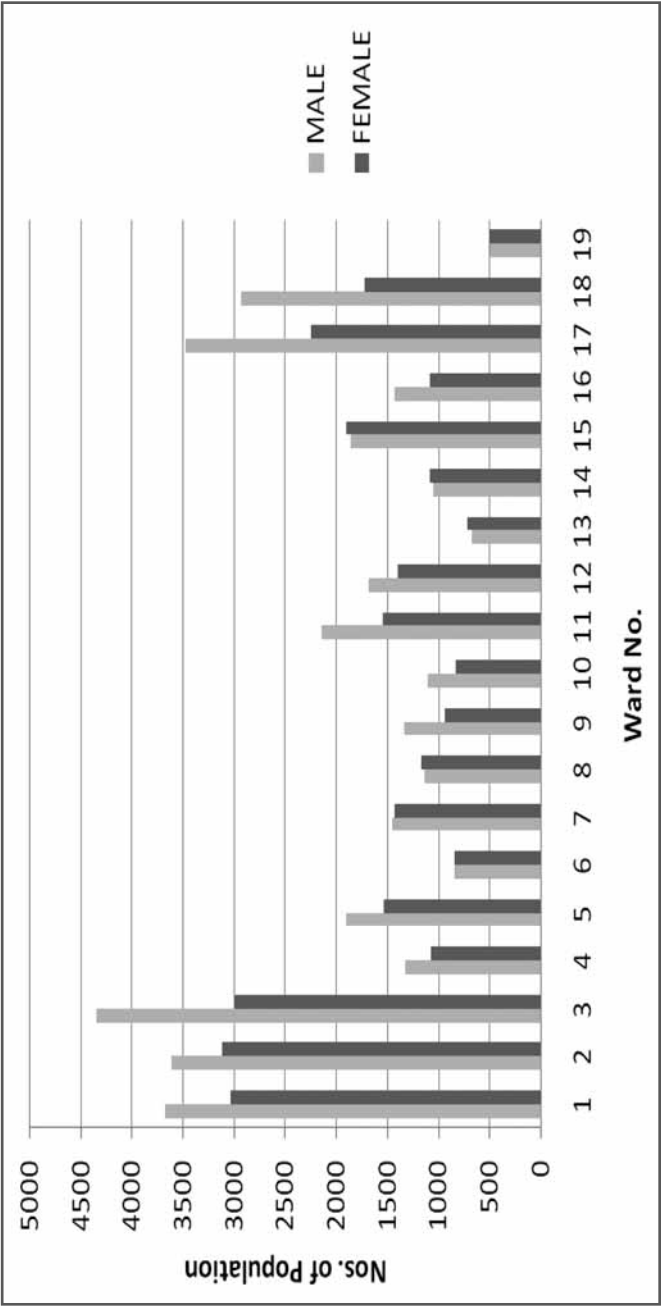
According to the 2011 population census, the total population of Kirtipur is 65,602 in which the number of male population (36,476) is slightly higher than the number of female population (29,126). Kirtipur municipality occupies the second largest densely populated area after Kathmandu metropolitan city in the Kathmandu district. With a total number of 19,441 households Kirtipur has an average household size of 3.37. Ward-wise population distribution is slightly unequal comparatively to the total area. So there is greater alteration of resource distribution (Table 4.1 p. 53 and Map 4.2 p. 58).

Table 4.1 Population Distribution of Kirtipur Municipality

WARD	Area/Ha	No. OF HHs	Population			Average HH Size
			Total	Male	Female	
1	43.11	1915	6708	3674	3034	3.50
2	71.89	1863	6728	3610	3118	3.61
3	170.75	2502	7343	4352	2991	2.93
4	5.93	690	2393	1324	1072	3.47
5	25.08	985	3439	1901	1538	3.49
6	25.19	429	1681	837	844	3.92
7	229.28	700	2877	1453	1424	4.11
8	313.4	504	2296	1133	1163	4.56
9	8.84	771	2272	1339	933	2.95
10	8.35	588	1934	1108	826	3.29
11	85.82	1148	3681	2140	1541	3.21
12	72.82	879	3077	1681	1396	3.50
13	126.94	360	1386	675	711	3.85
14	102.8	468	2129	1047	1082	4.55
15	235.11	850	3767	1864	1903	4.43
16	87.66	792	2510	1429	1081	3.17
17	56.12	2053	5732	3482	2250	2.79
18	34.52	1722	4661	2934	1727	2.71
19	97.74	222	985	493	492	4.44
Total	1801.35	19441	65602	36476	29126	3.37

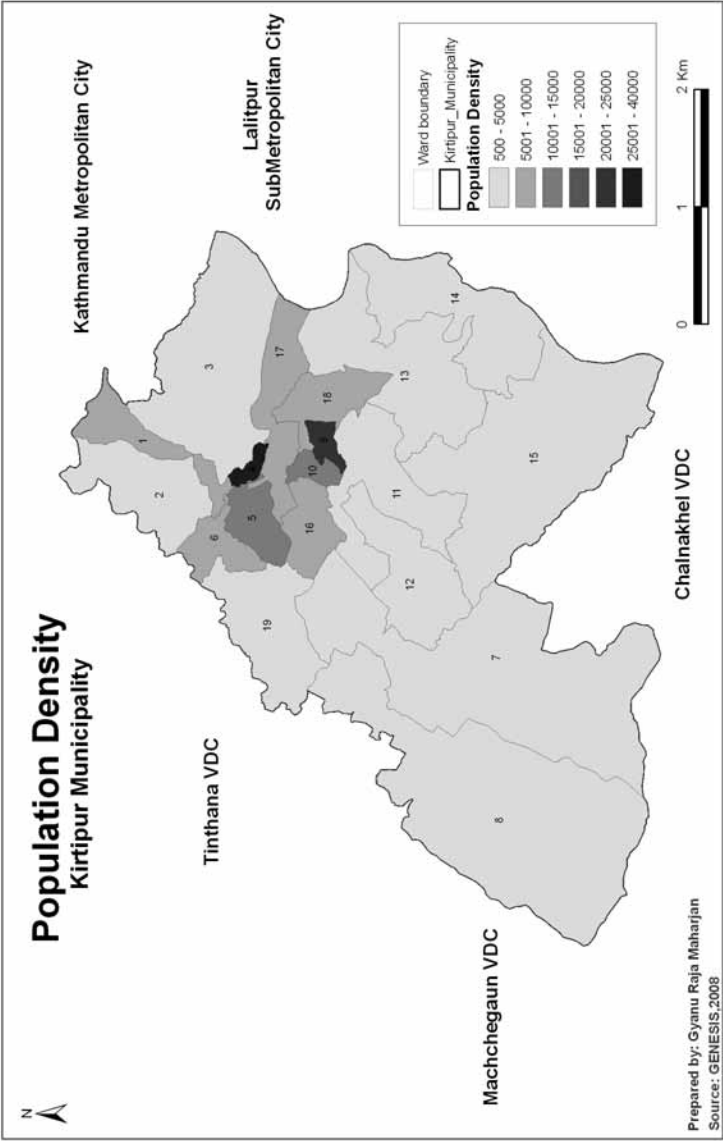
Source: CBS, Population Census 2011

Figure 4.1 Population Distribution of Kirtipur Municipality



Source: CBS, Population Census 2011

Map 4.2 Population Density Map of Kirtipur Municipality



4.5 Physical Infrastructure and Services

Physical infrastructure plays an important role in a planned local development. It is a visible indicator to measure a city's status as well as economic status. It covers mainly road, water supply, electricity and telecommunication networks.

4.5.1 Road Network

There is a total of 34.71 km metal road, 111.43 km gravelled road and 45.59 km track road within the municipality area. Metal roads are mainly running from the eastern side parallel to the Bagmati river connecting Kirtipur municipality with Kathmandu metropolitan city at northeast side and Dachhinkali area on the southeast. Besides, metal roads are connected with the core area of the city and Panga settlement, Tribhuvan University and Chobhar industrial area that is the Himal cement factory which has been closed for many years. All wards are accessible with the gravelled roads and track.

4.5.2 Water Supply Network

Water supply network is available in all parts of the settlements in Kirtipur. The municipality's two main sources of drinking water are the springs at Dudh Pokhari and Sim Jhawahiti located in ward No. 7. Each of them have a centralized piped water supply system with a capacity of 2200 lm^3 per day for Dodh Pokhari and 1000 lm^3 per day for Sim Jhawahiti. About 92% households have water connection. Due to the lack of drinking water supply, a large number of households in the municipality still depends upon traditional water sources such as wells, Stone Spout, springs, and ponds for daily activities except for drinking. A number of public taps constructed by the Water Supply Corporation (WSC) is able to supply water for an average of three hours, twice a day.

4.5.3 Electricity Network

According to the conversation made with the chief of the Kirtipur Branch Office of the Nepal Electricity Authority (NEA), the elec-

tricity facilities can be made available to the 100% population. However, only 6500 households (75%) are in consumer's list. Rest of the households are having illegal connection or extensions from neighbouring houses. As a result, zero metre has been the main problem faced by the NEA.

4.5.4 Telephone facility

Information on the telephone networks was obtained from the Nepal Telecom office in Kirtipur. Its office is located at Bahirigaon. There are 14 telephone cabinets with 420 distribution boxes (DB) having a capacity of 10 telephone line connections each. At present, there are 3500 subscribers connected. According to the Telephone Exchange Office, the present infrastructure could provide an additional 500 telephone lines.

Apart from the above mentioned infrastructure, waste management has been seen as one of the main infrastructure facilities in the municipal areas. However, there is no waste collection system within the municipality, as a result the households dispose their waste directly on the streets and open fields.

An Inventory of Water Resources in Kirtipur

5.1 Background Information

Kirtipur is a historic town as one of the oldest Newar dominant settlements with their own language and cultural norms and values in the Kathmandu valley. History explains that the ancient city of Kirtipur was founded by Shiva Deva between 1099 AD and 1126 AD and during the reign of the Malla Kingdom in the 15th century the city was developed for human settlements. Kirtipur's fortress was considered impregnable. The Gorkha King Prithvi Narayan Shah laid siege to it three times before 1768 AD finally taking the town and then, it is said, only after it had been betrayed. The line of the old town wall, pierced by 12 gates, is still clearly visible.

According to the 2011 census, 1,321,933 Newars in the country are the nation's sixth largest indigenous group, representing 5% of the total population. Recent mass migration into the Kirtipur area has resulted in the Newars becoming a minority in their own homeland. Due to the increased level of urbanization, the Newar culture, language and customs are under threat today. Its impact is also in the natural resources management system. The Newars are rich in culture, language and religion and the best example for that is numerous *jatras*, *pujas* and social ceremonies they manage to conduct even in today's fast changing life.

Water among other is the largest natural resources of Nepal. It is used for drinking, bathing, washing and cleaning, irrigation (esp. in agriculture), industries, hydropower generation, religious and recreation values such as swimming, fishing and different forms of eco-tourism. There are three states of water resources in Nepal i.e. (i) Surface Water Resources, (ii) Lakes and Ponds, and (iii) Ground Water Resources.

Nobody has known about the history of the establishment of water resources in Kirtipur. According to the old-aged people's view, many types of resources in Kirtipur were established in the very ancient time when the human settlement was started. So one can conclude that all types of water resources were established in the very beginning when the settlements were established in the different areas. The people had established the water resources in the surrounding areas and were managing properly. So these water resources are remaining till date. In those days the resources were well-managed and no water crisis was experienced. Nowadays people are suffering from water crisis because of explosive population growth and constant water resources. Such explosive population growth has directly affected negatively to the water resources.

There are different types of water resources in different areas in Kirtipur i.e. river, rivulet, lake, well, dug well, Stone Spout, pond and spring. It was invented in the field observation that most of the resources are available in dense forest areas. In those areas the people have maintained the resources till now and using the water in their livelihood. In Kirtipur, there are altogether 90 water resources in different areas. These resources are well, dug well, pond, river, Stone Spout, spring, lake, deep tube well, rain water harvesting and reservoir.

The present study has proved that the indigenous Newar settlements are dominant in Kirtipur and they had established the water resources since they started their first settlements. Most of the water resources were found where the indigenous Newar people are residing and very few water resources are found in other places, where the Hindu caste groups are living. The number of ward-wise water

resources and its distribution are given in the following table and map (Table 5.1 and Map 5.1 p. 65).

Table 5.1: Ward-wise Distribution of Water Resources

S.N.	W.N.	Types of Water Resources									
No. of→		Well	Dug Well	Pond	River	Stone Spout	Spring	Lake	D.Tu/ R. Wt	Reser voir	
1	1	2	-	1	-	1	-	-	-	2	6
2	2	3		4	-	3	-	-	2/-	1	13
3	3	3	-	1	-	1	-	-	-	-	5
4	4	-	1	-	-	-	-	-	-	1	2
5	5	1	3	3	-	-	-	-	-	-	7
6	6	-	4	1	-	2	-	-	-/1	1	9
7	7	-	-	-	-	-	3	-	-	6	9
8	8	1	-	-	-	-	2	-	1/-	3	7
9	9	-	-	1	-	-	-	-	-	-	1
10	10	-	3	1	-	-	-	-	-	-	4
11	11	-	2	1	-	-	-	-	-	-	3
12	12	-	-	1	-	-	-	-	-	1	2
13	13	2	-	-	-	1	-	-	-	-	3
14	14	4	-	-	-	-	-	-	-	1	5
15	15	-	-	-	-	-	-	1	-	-	1
16	16	-	1	1	-	-	-	-	-	-	2
17	17	2	1	-	-	2	-	-	-	-	5
18	18	1	-	-	-	-	-	-	-	1	2
19	19	-	1	-	-	-	-	-	-	-	1
Total		19	16	15	3	10	5	1	4	17	90

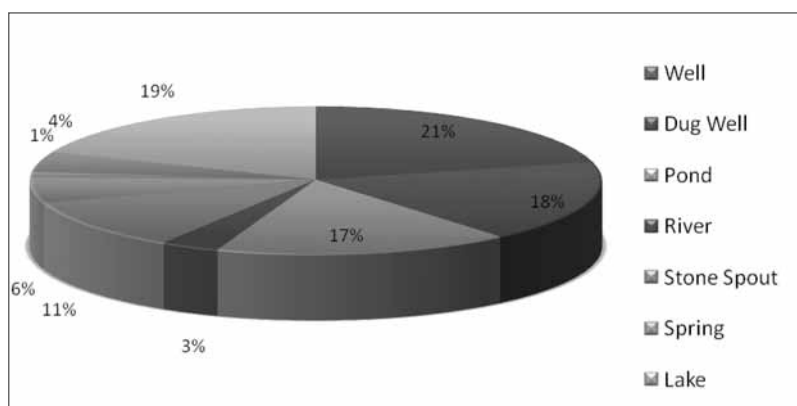
Source: Field Study, 2013

The distribution of water resources is not equal in all areas in Kirtipur. The ward No. 2 has the largest number (12) of water re-

sources and ward No. 19 has not any water resources which lie in the western lowland of Kirtipur Municipality. There are 3 main rivers i.e. Bagmati, Balkhu and Boshan and other rivulets which touch most of the wards i.e. 2, 3, 6, 7, 8, 15, 16, 18 and 19. There are 17 reservoirs in different parts of the municipality and two reservoirs are not using till now. Yet, it has not been used till date and other 15 reservoirs are connected for drinking water supply for the households and public taps in all parts of the municipality. The water connection is available in all the settlements and the supply duration and time is different in the day and week.

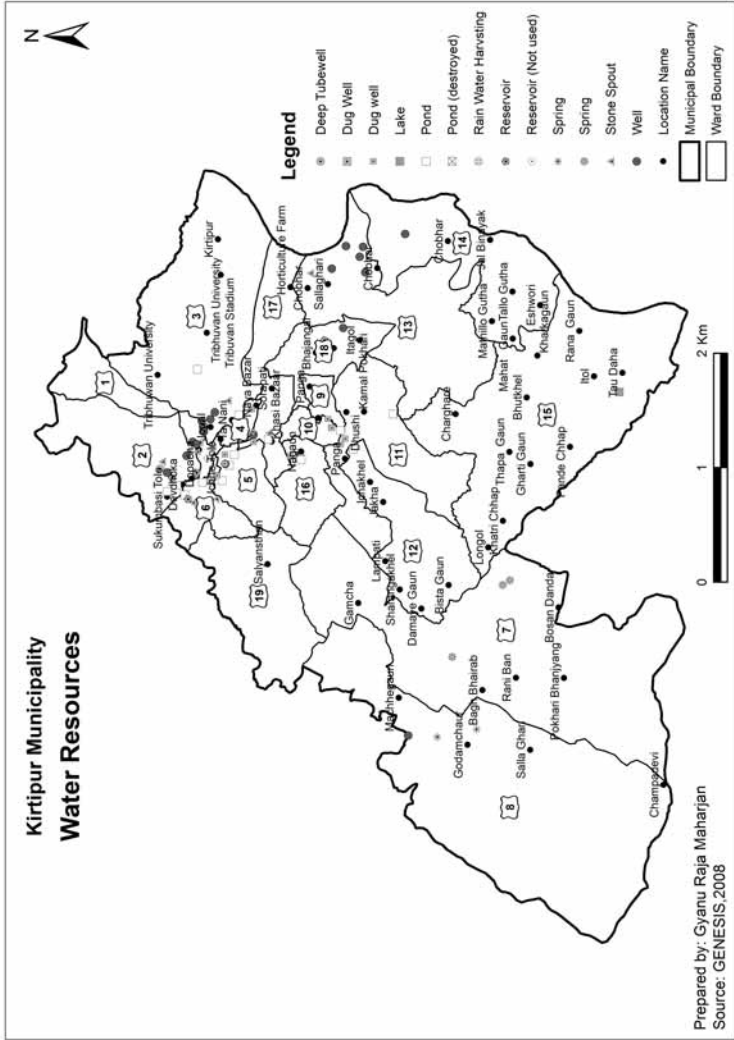
The largest numbers of wells are found in the core area of Kirtipur and Chobhar. Out of total 90 water resources, 25% of wells rank the first (19) followed by ponds (15) located in different settlements (Figure 5.1). The spring is very important water resources in Kirtipur, because this has been used for drinking water supply connection through the reservoir. There is a big lake named Taudaha (Annex IV: Plate 35) located in ward No. 15 which is very famous for cultural significance as well as popular tourist destination. People(s) are using this lake's water in washing and bathing purposes.

Figure 5.1: Percentage of Water Resources



Source: Field Study, 2013

Map 5.1 Water Resources Map of Kirtipur Municipality



5.2 Types of Water Resources and its Condition

a) Well (*Gaa, Kuwa*)

There are 19 wells existing in 9 different wards (Annex IV). Most of the wells were established in the forest or greenery parts of Kirtipur. Some wells are open and some are covered by cemented slab for protection. All the wells have sufficient water every time. People are using those wells for their daily activities.

b) Dug-Well (*Tun, Inar*)

Most of the dug wells are established in the core area of the settlements. There are 15 dug wells existing (Annex IV) in 7 different wards. The few dug wells have only sufficient water for household activities and most of the dug wells have not sufficient water because of not use and maintenance. The dug wells are 15-20 m deep and 1.5m diameter depending upon location. Some dug wells are covered by cemented slab, some are opened.

c) Pond (*Pukhu, Pokhari*)

The ponds (Annex IV) are located in the outer parts of the settlements. In ancient times people were using its water for drinking also but nowadays people(s) do not use for other household activities because of pollution. There are 15 ponds found in 10 different wards. All the boundaries of ponds are fenced and walled up by cemented wall and some ponds' water is used for washing purpose.

d) River (*Khusi, Khola*)

There are three main rivers i.e. Bagmati, Balkhu and Boshan (Annex IV) and other small rivulets like Kaara Dha, Dudha Dha and Yara Dha (rivulet) in Southern and Northern parts of the municipality flowing through the ward boundaries of 1, 5 and 2 respectively. The Bagmati river flows through 3, 13, 14, 15, and 17 ward Nos., the Balkhu river through 1, 2, 6, and 19 ward Nos., Boshan river ward Nos. 7 and 15, and the rest rivulets flow through 3, 7, 8, 13, 14, 15, and 18 ward Nos. The Bagmati river amongst them is the most polluted one and people(s) do not use its water in any activities

of their daily lives. Two other rivers and 3 rivulets have been used mostly in agricultural activities in different parts of Kirtipur. Urban agricultural practices are going on in some parts, where the river water is available.

e) Stone Spout (*Lwonhiti, Dhunge Dhara*)

Dhunge Dhara 'Stone Spout' is a traditional stone water tap found extensively in Nepal. They were commissioned by various rulers of Ancient and Medieval Nepal. *Dhunge Dharas* were made both for public and private use, and consist of intricately carved stone water ways through which water flows uninterruptedly from underground water sources. Some of them were later made from metals like copper and silver as well. The meritorious function is combined with the form in a way that it creates the individually magnificent monuments and enhances the architectural design of any urban area. Not only for the mere use of drinking water, it has a great significance in social, cultural and historical aspects.

Stone Spout means the tap using the stone carving tap for the mouth of water channel from the ground water sources. Most of the Stone Spouts in the past were established in holy places. There are 10 Stone Spouts in 5 different wards. All the Stone Spouts' water is very clean except 1-2. Some Stone Spouts are made up of god and snakes' pictures which are carved in the mouth of Stone Spouts. One Stone Spout's water contains maximum quantities of Sulphur Oxide, Iron and it looks like orange in colour. This source is located near the agricultural fields and nobody uses this water in daily life activities.

f) Spring (*Padhera*)

There are 5 springs in 2 different wards in the forest areas of Kirtipur municipality. All the drinking water supply connection is taking from the springs water located in ward No. 7. The 2 springs are using locally for different household activities. The quality of spring water is very good and people are drinking directly without treatment. There are no treatment plants in any reservoirs.

g) Lake (*daha, tal*)

There is only one Lake located in ward No. 15 named Taudaha (Annex IV: Plate 35). It is very famous for cultural, religious and touristic view. Nowadays, many people come to visit for entertainment. Its cultural significance is of great importance. It covers very large surface of that area.

h) Deep Tube Well

There is one Deep Tube Well recently built in ward No. 2 by the Kathmandu Valley Drinking Water Supply Limited, Kirtipur Branch. It is 130 m deep underground. It is not used till now. It will very soon be in use for supplying the drinking water in Tyangla Phat area.

i) Rain Water Harvesting (*Aakase Pani Sankalan*)

In ward No. 6, there is one new settlement for quarters which was shifted from Bishnumati corridor link-road area. There are 46 households altogether and they do not have drinking water connections. They manage their drinking water from the neighbouring settlements and for other daily activities they manage water from the rain water harvesting collected in one underground big tank.

j) Reservoir

There are 17 reservoirs in different hilly parts of nine different wards. The drinking water is collected from spring resources in those reservoirs and supply to the household and public connections from time to time. Therefore, all reservoirs were constructed on the highest parts of Kirtipur, Bhajangal, Dud Pokhari and Sim Jhawahiti area. All the wards and lanes (Toles) have their public water tanks in their locality for collecting water and use the collected water when necessary from those tanks.

5.3 Utilization of Water Resources

The drinking water connections are not sufficient for daily life activities of the local people in Kirtipur. So they are using water from other sources which are located in the nearest distance (Table 5.2). The availability of water resources is very useful and helpful in their

daily life activities. In the case of other rural areas of Nepal, people have difficulty to get water. They have to walk 2-3 hours for fetching drinking water and most of the time is spent for collecting the water. However, in Kirtipur the availability of water resources is helpful for saving people's time to be engaged in their local developmental activities.

Table 5.2 Water Resources Using in Different Activities

Water Resources	Well	Dug Well	Pond	River	Stone Spout	Spring	Lake	D. Tu R. Wt	Reservoir	Total
Nos. of Resources	19	16	15	3	10	5	1	3/1	17	90
Utilized in	Nos. of Resources									
Drinking	9	2	-	-	3	5	-	3	-	22
Washing	19	12	2	2	6	5	1	4	-	51
Bathing	17	11	-	2	8	5	1	4	-	48
Toilet	7	13	8	2	1	5	-	4	-	40
Cleaning	6	7	1	2	2	5	-	4	-	27
Dish Wash	6	9	1	-	5	5	-	4	-	30
Livestock	5	5	5	2	1	5	1	4	-	28
Agriculture	11	7	16	2	7	5	1	1	-	50
Making Liquor	-	2	-	-	-	-	-	-	-	2
Construction	-	5	10	2	-	2	-	1	-	20
HHs Supply	-	-	-	-	-	-	-	-	15	15

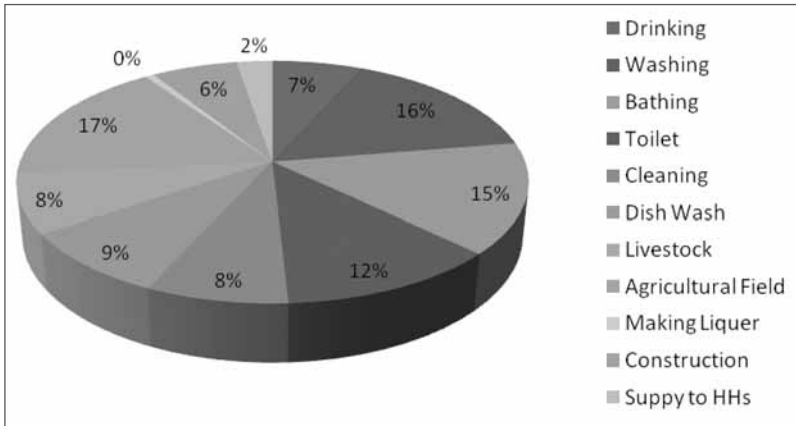
Source: Field Study, 2013

Reportedly 82 of water resources have been used in different activities. There are 50 (17%) of water resources used in agricultural activities. All the available sources have been used in irrigation. Agriculture is the main economic activities of the people in Kirtipur. Therefore, these resources are very helpful economically in local development too. There are some parts, where the people are distilling liquor for their livelihood. They are using water from 2 (<1%) resources of dug wells for such purpose.

Due to the lack of piped-water connection, the people are using about 47 (16%) of recourses for washing their cloths and 44 (15%) of recourses for bathing which is the second largest resources utilized in daily activities in Kirtipur. Another important activity of water use is drinking and most of its sources are springs. Nonetheless people are drinking water from other sources like well, dug, well, Stone Spout and deep tube well due to the lack of drinking water connections and crisis.

About 20 (7%) resources have been used for drinking purpose. Despite 3 main rivers and other rivulets in Kirtipur, only 2 river water has been used for irrigation, washing and other activities. Since Bagmaiti is severely polluted, no water nowadays is used at all (Figure 5.2). One well is located in Chobhar (ward No. 14) which is only used to offer god (*Adinath* temple) worship purposes i.e. *Jal* for people, bathing *Pujari*, and other purification purposes. Only *Pujaris* use the water of the well and no one is permitted to enter inside the well. It is locked all the time. Three tube wells are constructed in Ward No. 2 and 8 by KUKL for drinking purpose.

**Figure 5.2 Percentage Uses of Water Resources
in Different Activities**



Source: Field Study, 2013

5.4 Water Quality

Quality of water is very important part of human life. If the water is of poor quality people's health is affected seriously. So the people using the water must be of very good quality. Different organizations have carried out water quality test of different water sources. From those reports the quality of water in Kirtipur is not so poor. In this research also it is found that the quality of water is very good and most of the resources are used by the people for drinking and other purposes. The drinking water was supplied without any treatment plant for the household connection which is coming from the spring resources and only tube well water is supplied after water treatment. Only the chlorination process has been done before water supply to the household connection. In lack of drinking water supply, most of the resources are used for drinking except some resources like well, dug well, stone spout, pond etc. These resources are used in other household activities.

5.5 Water Pollution

During the field work of this study, different water resources are in good condition since most of the resources are managed by the indigenous Newar local communities and user's groups. Most of the wells and springs are found in the greenery or forest area where the availability of water is very rich. There are no garbage and waste materials found in the resource sites. Therefore, the resources are very clean and no water pollution. Some resources are surrounded by dumping sites and sewerage pipe lines so that their resources are in very poor condition and polluted. Such water is not suitable for drinking and other purposes as well.

Some ponds are found in bad condition nearby some settlements. The settlement's most water discharge areas are in ponds and well because every space is occupied by human settlements. So in the rainy season the rain water is collected in the pond and discharged in the soil. But the condition of pond is very poor and polluted. People are using the pond as dumping site and throw the waste materials in it.

Another reason for direct impact up on the water resources is human encroachment haphazardly. Uncontrolled population growth seriously causes water scarcity and pollution since Nepal lacks garbage management system. Therefore overproduction of waste materials with the speedy growth of population has direct negative impact on the water resources and pollutes its uselessly. In Kirtipur, most of the areas have the sewerage pipe line network and cemented-stone paved for modern civilization and cleanliness. Nobody has any idea about its negative impact in the water resources from such modern developmental works. In those areas there seems no water discharge and recharge activities take place during the rainy season and other waste water from household activities.

5.6 Water Resources: Existing Situation

Some resources are in the process of disappearing because of pollution and improper use. In some parts of Kirtipur, different resources

are being drying up since such resources have changed into dumping sites or waste land. Its surroundings and localities are highly polluted. People have no idea about the water resources and also the lack of budget for management of it. Therefore, they converted potential resources into public buildings, open spaces for public use etc. The following table (5.3) shows that the distribution of resources at risk in different wards used for different purposes.

Table 5.3 Water Resources Destroyed and their Status

S.N.	W.N.	Water Resources	Location	Status
1	1	Pond (destroyed)	Thambahal, Kirtipur	Open Space
2	2	Well (destroyed)	Galchhe, Kirtipur	Covered Grass
3	2	Pond (destroyed)	Galchhe, Kirtipur	Dumping sites
4	2	Pond (destroyed)	Ga, Kirtipur	Open Space
5	3	Well (destroyed)	Chithu, Kirtipur	Covered Grass
6	3	Pond (destroyed)	Nayabazar, Kirtipur	Open Space/ Dumping sites
7	3	Pond (destroyed)	Nayabazar, Kirtipur	Build Building (Sahid Smarak College)
8	5	Pond (destroyed)	Sagal Tole, Kirtipur	Build Private Building
9	5	Well (destroyed)	Hitigaa, Kirtipur	Open Space (Public Building)
10	9	Pond (destroyed)	Bhuine, Panga	Dumping sites
11	11	Pond (destroyed)	Dane, Panga	Dumping sites
12	16	Pond (destroyed)	Nagaon	Build Public Building
13	16	Pond (destroyed)	Nagaon	Open Space
14	17	Pond (destroyed)	Nayabazar	Build Private Building

Source: Field Study, 2013

Newar Indigenous knowledge of Water Resources Management

Most of the water resources in Kirtipur are located in the indigenous Newar people settlements. So these resources are mostly managed by the local Newar people in Kirtipur municipality areas. Only the drinking water is distributed by KUKL Kirtipur Branch. The local water resources are assets of the local people, therefore they have responsibility and priority to maintain and manage the water resources for survival locally and their development.

6.1 Status of Water Resources in Nepal

Nepal has more than 6000 rivulets and rivers. Annual mean flow of major rivers is estimated to be 4930m³/sec. This amounts to 70% of total surface runoff. About 60-85% of surface runoff occurs during monsoon (Lekhak and Lekhak 2003).

- Lakes, ponds and reservoirs amount to 30% of the total surface runoff.
- Total available surface water potential is estimated to be 224 billion m³.
- Estimated ground water potential is 12 billion m³.
- Current ground water withdrawal is 0.52 billion M³/year.
- Per capita internal renewable water resource declined from 13,800 m³/year in 1984 to 10,300 m³/year in 1998.
- Surface and ground water quality has deteriorated. According to a recently published World Water Develop-

ment Report, Nepal ranked 781st in the global water quality assessment study. UN's report ranked 122 countries according to their quality of water as well as their ability and commitment to improve the situation.

- Water level has lowered substantially due to low recharge which is a result of decreasing forest coverage, increasing urban build-up and other non-agricultural activities.
- Water demand for irrigation has increased tremendously. The irrigated area expanded from 0.739 million ha in 1988 to about 0.88 million ha in 1998. About 90% of withdrawn water is used for irrigation.
- Despite having the capacity of 83,000 megawatt hydro-power generation, only about 600 megawatts has been generated so far i.e. 0.7% of the total potential.

6.2 History of Drinking Water Supply in Kirtipur

Thousands of years before the name remained Padam Kasthapur Giri (Puri) of Kirtipur has old historical background. The people had discovered the different water resources and have been using in their livelihood activities for a long time. During that period they had managed different resources in their locality by their own effort, e.g., well, dug-well, Stone Spout etc in different areas in Kirtipur. In 1890 BS during the time of Prime Minister Bhimsen Thapa, one very long canal (*Raj Kulo*) was constructed which was using water supply from Dhud Pokhari to Bhim Pokhari for drinking purposes. Nowadays the canal has been destroyed and the condition of the pond is also drying because of mismanagement.

The first 4 inch drinking water pipe line was brought in 1994 BS from Lhonkot. After 1996 BS a total of 13 public taps i.e Layaku, Baghbhairab, Chithu, Bhariya Pukhusi, Tujho, Lhodega, Kutujhol, Paghu, Khasi Bazar, Sagal, Samal, Devdhoka and Galchen areas have been distributing the drinking water. After some year, the local people of Bosigaon, Taukhel, Naikap, Salayansthan, Majhagaon, Tyanglaphat etc have taken the water from the main water pipe line of Lhonkot. It has caused water scarcity in Kirtipur again and addi-

tionally the steady growth of population has also caused acute water scarcity.

After the political change in 2007 BS, the public taps were upgraded in numbers till 1916 BS. One reservoir in 2035 at Kwacho was started to construct which has 200,000 Litres capacity of water storage and was completed in 2040 BS. Then, the drinking water was distributed for the public in Kirtipur. Again the water crisis is remaining the same and another water supply in 4 inch pipe line connection from Bhajangal reservoir was supplied to Kwacho reservoir.

In 2051 BS, another Drinking Water project had jointly been established by Plan International Nepal, Drinking Water Corporation, Kirtipur Drinking Water Management Committee and Local Community participation. This project established new reservoir at Chilancho and 4 inch water connection from Sim Jhawahiti in 2053 BC. The reservoir's storage capacity is also 200,000 Litres. Before the establishment of the Kirtipur Municipality there were four VDCs in Kirtipur for the distribution of drinking water mostly in public tap (Table 6.1). The Public water connection is available in each Ward and Tole with their water tank for collection and distribution to all households in the morning and evening time.

Table 6.1 VDC-wise Distribution of Water

S.N.	VDC	Public Tap	Private Tap	Nos. of Water Tank
1	Layaku	28	4	25
2	Chithu Bihar	19	Most of the houses in Nayabazar	9
3	Paliphal	20	5 (Like Public)	10
4	Bahirigaon	9	Most of the houses in Nayabazar	6* (* Only in wards 3 & 4)

Source: News & View of Kirtipur, 1996

6.3 State of Drinking Water

Safe drinking water is a basic health need. Nearly, two thirds of our body weight is maintained by water. Much of ill health is largely associated with the lack of safe drinking water. Diarrhoea, dysen-

tery, typhoid, cholera, hookworm, pinworm and roundworm etc are common diseases caused by the lack of safe drinking water. Water shortage becomes serious especially during three months preceding the monsoon, when particularly women and girls have to walk long distance to fetch even a minimum quantity of water. All of which leaves less time and energy with them for other essential works. It also poses serious health risks.

No treatment plant for drinking water is established in the reservoir or supply station in Kirtipur. It is just put chlorine in reservoirs time to time. In this research nobody was found ill from the chlorine-mixed drinking water. It is concluded that the drinking water of Kirtipur is of very good quality because of spring water resources. About 64% households have drinking water connection. Other households are sharing the drinking water from their neighbourhood households and using other resources like wells, dug-wells, Stone Spout, springs (Table 6.2) etc. So such water resources are also considered as quality drinking water.

Table 6.2 Number of Households by Main Source of Drinking Water

Ward	Total HHs	Households by Main source of Drinking Water						Source not stated
		Piped Water	well	Tube well	Spring water	River/ Stream	Others	
1	655	555	76	1	12	0	9	2
2	510	359	145	2	2	0	2	0
3	1278	1212	58	1	0	0	5	2
4	388	334	0	0	51	0	0	3
5	363	361	2	0	0	0	0	0
6	271	183	26	0	62	0	0	0
7	418	322	80	1	9	0	0	6
8	393	366	9	0	0	0	15	3
9	474	469	1	0	0	0	0	4
10	229	229	0	0	0	0	0	0
11	489	487	0	1	0	0	0	1
12	409	406	0	0	1	0	0	2
13	321	321	0	0	0	0	0	0
14	447	446	0	0	0	0	0	1

Ward	Total HHs	Households by Main source of Drinking Water						Source not stated
		Piped Water	well	Tube well	Spring water	River/ Stream	Others	
15	632	626	1	0	1	0	0	4
16	349	348	0	0	0	0	0	1
17	1097	1079	2	1	9	0	1	5
18	617	616	0	0	0	0	0	1
19	147	47	14	0	86	0	0	0
Total	9487	8767	414	7	233	0	32	35

Source: MUAN, Municipal Database Analysis of Nepal 2006

People of Kirtipur municipality are getting drinking water from various sources. However, piped-water (tap) is the major source of drinking water. Out of total households of the municipality, about 92% households get pipe water. Similarly, about 4 and 3% households fetch water from well and spring respectively. Besides these sources, some people of the municipality depend on tube-well and other sources too for drinking water.

The proportion of households depending on different sources of drinking water is varying in different wards in Kirtipur Municipality. The percentage of households using piped-water is ranging from 32% in ward No. 19 as the least to 100% in ward No. 10 as the highest proportion. Piped-water could be considered as relatively reliable and safer source of drinking water; however, the percentage of households using natural spring for drinking water is relatively higher in ward No. 19 and 6. Similarly, 28% households of ward No. 2 and 19% households of ward No. 7 are fetching drinking water from well.

6.4 Indigenous Knowledge of Water Resources Management

Nobody can create natural resources besides in labs in limited quantities for experimental purposes. In the same manner water resources also cannot be created for the whole living organism on earth. Water is fundamental to human security in both tangible and intangible

senses. Drinking water supply, food and livelihoods are the three basic tangible aspects of water use, while groundwater recharge, recreation, and socio-religious functions are its intangible dimensions. Both dimensions contribute to human security and happiness. It comes naturally by natural process. If the natural process is not managed properly, we have to face water scarcity, and water pollution. So we have to always manage water resources properly.

But some resources like well, dug-well, pond, stone spout, etc are created by the people when new settlements started in Kirtipur. They have certain religious and traditional norms and values of water and worship water god (*Jal dewata*). In those days the Newar people had no equipment to measure suitability of places for making new water resources. Even then they were successful to choose the appropriate location for making water resources which one can see the existing ones. In the process of establishment of such water resources, first they do soil testing with the help of Astrologers (*Gubhaju*) through astrological calculations and use *tantras* for good location and appropriate date. In the fixed date all the people attend and do the worship or *puja* to water god, celebrate feast and start work from that day and continue till the last when the water resource would be ready. Such ritual was very effective and useful throughout the municipality area while in the field observation for this research.

In Kirtipur, all the Newar houses in the past were traditional and till date most of the houses have kitchen garden. There is a traditional sink, locally called *Dhow Pwo* which is generally built in the kitchen for the disposal of waste-water produced in cooking and hand washing and mouth rinsing. This traditional sink consists of bowl shaped burnt clay with narrow open burnt clay pipe called *Chee Dha*, conveying waste-water to a multipurpose waste-water collection pit, known as *Saagah* (*Saa* in Newari means 'manure' and *gah* means 'pit', thus *Saagah* stands for pit excavated for the collection of waste-water preparation of compost manure). The waste-water collection pit or *Saagah* is generally found developed on an open space at the backyard of the house where solid and liquid wastes generated in the house are dumped for composting.

There is also practice of making a common *Saagah* in the courtyard. Traditional Newar settlements generally involve clustered housing stem with a courtyard at the middle which is a common open space shared by the inhabitants.

Waste-water from kitchen, biodegradable wastes and excreta from livestock are all collected and dumped in *Saagah* for composting. A small outlet made in the *Saagah*, called *Byeku Pwo* is connected to an earthen conduit, called *Nali* which drains the waste-water to the collector drains, collecting waste-water from all households in their neighbourhood. The level of outlet in *Saagah* is set at a level that as soon as the pit is filled with waste-water to the level of the outlet it starts draining into the channel. The water goes from the channel to the kitchen garden and soil as well. It helps to water recharge system very well. The waste-water thus collected is either conveyed directly to the crop lands for irrigation uses or stored in the system of ponds from where the waste-water is recycled for subsequent irrigation uses. The ponds serve the purpose of oxidation tanks and hence they are part of traditional waste-water treatment system and recharge the ground water as well.

Now, many Newar houses structures have changed into modern houses and the kitchen gardens have been replaced by new houses because of large family members. So all the house system of water resources management also has changed and they didn't realize about their indigenous knowledge about water resources management. As a result, they are suffering from the negative impact of modernization.

Another very useful recharge system in Kirtipur is rooftop water harvesting system in rainy season. The structure of house roofs in Kirtipur are sloppy which helps the rain water go down in all part of the soil and the water goes down on the earth surface properly and help in water recharge system very properly. Although the volume of water used to recharge groundwater in these few cases have not been quantified, water thus injected rarely spills over the pit even during heavy rainfall events. This suggests that

even during the monsoon there is enough space to absorb the incoming water. Even if only half of the water could be recovered, the contribution of rooftop rainwater harvesting for water availability could be significant.

In the past, every households used to have septic tank. The structure of the septic tank was/is made by bricks with holes on the wall from where the toilet waste-water goes into the tank and the water is absorbed by the soil. This process also helps the water recharge very well. Nowadays the toilet system has also been changed. Today, there is no need to make septic tank for collecting the toilet wastage and water. The toilet system is connected to the sewerage system with home pipe and the wastage directly goes to the river. This has caused the worst negative impact in ground water recharge system.

The inner streets of Kirtipur were stone-paved with mud in the very beginning so that all the rain-water used to be stored underground during raining season. Similarly, all the waste-water used by the people for bathing, washing in open spaces used to be absorbed into the soil and automatically the ground water was maintained. Nowadays the streets have been cemented with stone pavements with no systematic drainage system. It has also affected the ground water recharge system very badly.

In a faster growing city like Kirtipur, the Newar indigenous knowledge has been undermined and forgotten completely. As a result, the water level has gone down and many water resources have been lost and the people are suffering water-crisis day by day. The migrated population is also increasing day by day. During the last decade, about 50% of massive influx has caused havoc in natural resources like water.

In Nepal and indigenous peoples' context, the water has religious and traditional values from the beginning therefore resources have been maintained well till date, however modern people with vexed economic interest people have neglected such indigenous values and practices which has resulted in resources degradation. Thus, in this study we have observed how different institutions have man-

aged and distributed water resources in Kirtipur (Table 6.3) and its surroundings.

6.4.1 Institutional Involvement

i) Local Clubs

Local Clubs have managed 11 different resources (Table 6.3) in various locations of Kirtipur. They have managed sources as per their need. The local water resources are used by the local people through local clubs formed under the leadership of the local people. Therefore, they are doing well in their local water resources management for sustainable uses.

Table 6.3 Water Resources Manage by Different Organizations

Water Resources	Well	Dug Well	Pond	River	Stone Tap	Spring	Lake	D. Tu/R. Wt	Reser voir	Total
Nos. of Resources	19	16	15	3	10	5	1	3/1	17	90
Managed By	Nos. of Resources									
1. Local Clubs	3	1	4	-	3	-	-	-	-	11
2. Local Communities	11	11	12	-	7	-	1	-	-	42
3. User Groups	8	2	1	2	2	2	-	-/1	-	18
4. KUKL	-	-	-	-	-	3	-	3/-	17	23
5. Private	-	1	-	-	-	-	-	-	-	1
6. No Body	-	1	-	1	1	-	-	-	1	4

Source: Field Study, 2013

ii) Local Communities

Local Communities are similar to the Local Clubs. Some of local communities themselves are managing their local water resources for sustainable use. All together 42 water resources (Table 6.3) are managed by the local communities in different parts of the Kirtipur

municipality. Local communities have responsibility to manage their own local water resources for providing water for daily activities of the people and for living beings as well.

iii) User Groups

In some parts, the water resources are very far from settlements or no settlements are near the water resources. In those areas such resources are managed by users' groups. User groups are the groups of people who are mostly using their water in different activities. There are 18 water resources (Table 6.3) which are managed by the users' groups. Mostly no settlements are on the river side. Other resources like well are mostly located in greenery areas or are out of settlement areas. Those resources used in different parts of the settlements are managed from time to time for sustainable use by the user groups.

iv) Kathmandu Upatyaka Khanepani Limited (KUKL)

Drinking water supply in Kirtipur is distributed by the KUKL Kirtipur Branch. Its responsibility is managing drinking water supply and reservoirs. So a total of 23 resources (3 springs, 3 tube-well and 17 reservoirs) are managed by KUKL. Its work is to collect the water from different resources in the reservoirs and supply drinking water to the households through public connections. All the settlements in Kirtipur have drinking water connection, however water distribution time differs. Some areas have regular water supply, some have alternate day, some have once a week, some have early morning, some have morning, some others have day, evening and some have at night. The water supply time duration (e.g., 30 minutes, 1 hour, 2 hours) also varies in locations. Therefore all the people of different wards have complaints to the KVDWS office about the irregularities of drinking water supply. They are ready to pay their water bill when sufficient supply.

v) Private (Water Tanker Services)

Only one resource like dug-well (with large diameter) is managed by the private households located in people's house compound. Therefore, the dug-well is managed by themselves. In ward No. 15,

there are more than 5 private companies to serve water tanker service. They are distributing the drinking water commercially. They fetch the water from their neighbouring VDC named Chalnakhel. The other source is one big spring named Naumule. Those tanker service companies have pipe-line from that resource to connect their own reservoirs and treatment of that water and to supply the water tanker fill service. More than 100 tankers from each company fill water in a day and supply to the schools, campus, hotels, departmental stores and hospital etc. One company has produced the mineral water-pack in bottle as well. These 3 companies pay tax for using the water to the Chalnakhel VDC and 15 Ward office of Kirtipur.

There is one newly established deep tube-well in Jalbinayak, Choibar. They are supplying the water through tanker. About 100 tankers supply water daily from this resource to the water-scarce locations and hotel, hospitals in the valley for domestic uses. It is not studied yet if the tankers have any impact on the water discharge downstream, though the local respondents feel they have been impacted. What can be confidently expressed is the fact that the water demand in the valley is going to rise and so will the tanker trade. However, if there is no restriction on how much water can be allowed to be taken away, a day could come when the local users of the catchment will be affected visibly.

Four resources seem not to be managed by nobody because the resources are in poor condition and nobody is using those resources. The water quality is also very poor. So no institutions are responsible to those resources.

6.4.2 Duration of Maintenance

When the water resources are maintained from time to time, then it will be sustainable for use. Different water resources are found in the different locations and those resources are maintained by different local organizations in the different time duration which is shown in Table 6.3. One resource is maintained in half-yearly basis, 32 resources yearly, 2 during *Gai Jatra*, 5 in *Sithinakba*, 4 within 2-3 years, 27 not fixed and 4 resources are left without maintenance (Table 6.4 p. 88).

Sithi Nakha

Sithi Nakha - a unique Newa:(ri) festival (believed to be a special day of fear) which usually falls in June-July, on which the local inhabitants have a tradition to clean their own traditional public water sources. The reason behind the cleaning of water sources is that it is the starting time for monsoon. Recharging ground water can supply clean water sufficiently through the sources during the whole monsoon season. The tradition of cleaning in the valley has been continuing since the Lichhavi medieval period. Nowadays, the people also observe 'Water Day' in the Kathmandu valley. The scientific reason behind this survey is that the sources of water must be cleaned since the starting of monsoon each year so that the ground could absorb water sufficiently to supply pure water during and after the monsoon period. The festival has its own importance in Kirtipur where dense settlements are located.

Sithi Nakha is an indigenous traditional festival of the residents of the Kathmandu valley including Kirtipur. It is celebrated at the onset of the rainy season. The Newar Indigenous community in the valley celebrate it by worshipping *Kartikeya* or *Kumar*, son of *Lord Shiva* and *Parvati*, by preparing a small feast including the traditional Newar dishes called *Wo* and *Chatamari*, and most importantly, cleaning the nearby water resources. *Sithi Nakha* is also the last day for performing annual offering to the ancestral or guardian deities amongst the Newar community.

Newar is a community that has preserved the cultural heritage especially through several festivals still being celebrated the way they did hundreds of years ago. They are celebrating many feasts and festival in whole year and *Sithi Nakha* is a one of them. It is celebrated by cleaning the ponds. The culture is a legacy left behind by the Newar ancestors. If we promote this festival widely it can once again create awareness to propagate the value of pond in ground water recharging, irrigation, and environmental sanitation.

Apart from religious and cultural importance, *Sithi Nakha* is more related to water resource conservation and sanitation. People one that day clean all traditional water resources like stone-spouts,

dug-wells, ponds, water holes etc. They believe that the rulers of water wells—*Nagas* ‘snakes’ leave the wells for other destinations, as the water level goes down almost to the bottom because of the driest period of the year and the monsoon rains have not come yet. Similarly, the festival activities include cleaning of the house and its surroundings.

Many organizations working on Water and Sanitation sectors have been promoting *Sithi Nakha* as the National Sanitation and Water Conservation and have organized different activities of awareness, promotion and revival of *Sithi Nakha* activities. CIUD urges this festival to be supported nationally in an effort to both preserve water sources and promote rainwater harvesting. Realising the importance of *Sithi Nakha* not just as a festival but as a platform to raise public awareness about water source cleanliness and conservation, NGOFUWS has attempted to promote this indigenous festival as the National Day of Water Conservation and Cleanliness.

6.5 Development Impact on Water Resources

As a result of development all the areas of old Kirtipur’s inside lanes are paved with cement without any drainage system nowadays. This cemented process has created the problem of proper rain waters absorption into the soil and are shifting to the river through sewerage pipeline. Therefore, the water recharge is very poor then the level of water goes very low so that all the resources are in dried condition. In the past, Kirtipur’s inside lanes were stoned only with mud in absence of cement and no sewerage pipelines were used. Such knowledge and technology helped the rain water and household waste water to be absorbed into the soil then kept the water level maintenance in balance and always the water resources like well, dug well, stone tap, pond etc were full of water. The situation these days is very adverse due to developmental disasters.

Table 6.4 Duration of Maintenance of Water Resources

Water Resources	Well	Dug Well	Pond	River	Stone Tap	Spring	Lake	D. Tu/R. Wt	Reservoir	Total
Nos. of Resources	19	16	15	3	10	5	1	3/1	17	90
Duration	Nos. of Resources									
Half-yearly	1	-	-	-	-	-	-	-	-	1
Yearly	10	4	7	-	4	5	1	-/1	-	32
Gai Jatra	-	-	2	-	-	-	-	-	-	2
Sithinakha	-	5	-	-	-	-	-	-	-	5
2-3 years	1	2	1	-	-	-	-	-	-	4
Not Fixed	7	3	4	3	5	-	-	3/-	16	41
No maintain	-	2	1	-	1	-	-	-	1	5

Source: Field Study, 2013

6.6 Demand of Drinking Water

Runoff is the excess of precipitation over evaporation and infiltration and represents in a broader sense—the water available for human use. Globally, fresh water is abundant. Each year an average of more than 7000 cu. in water per person enters streams and rivers. However, the water is not available where and when it is needed.

Two common measures of human water needs are ‘withdrawal’ and ‘consumption’. Water withdrawal is taking water from the ground water or surface water source to a place of use. Water consumption occurs when water that has been withdrawn does not return to the source of withdrawal so that it may be used again in that area. This usually occurs because the water has evaporated or transpired into the atmosphere worldwide about 60% of the water consumed.

In the context of Nepal, the government of Nepal gives authority to National Drinking Water Supply for service and provides the drinking water connection to the whole country, however there are only 23 districts (28 Municipalities, 11 Zones) that have drinking water supply networks.

In Kirtipur, all the service of drinking water supply is done by the KUKL Kirtipur Branch. There are 19,441 households in Kirtipur municipality and about 7,051 households have drinking water connections. However due to unequal distribution water, there is scarcity in most of the wards and people are depending upon other water resources for their daily activities like washing, bathing, dish wash, agriculture fields, livestock, drinking etc. All together 65,602 people are living in Kirtipur municipality. In average Nepali standard the drinking water is needed 100 L per person per day for their daily activities. The water demand is 65,60,200 L per day in the municipality.

6.7 Supply of Drinking Water

The drinking water supply does not meet sufficient amount in most parts of the country. The Drinking Water Supply Corporation (DWSC) is not able to manage the drinking water in all parts of the country. Due to lack of technical equipments, man power and lack of knowledge, their service is not satisfactory. Among other things, uncontrolled population growth is the main cause of drinking water scarcity. The DWSC is not able to manage the drinking water as per the growth of population. They are supplying the same quantity for decades when the population has doubled.

In Kirtipur, there is water supply from 8 reservoirs to the households' connection and public connections. The supply time differs in different places and the quantity of water also differs. The KVDWS, Kirtipur Branch is supplying drinking water about 30,37,500 L per day in the whole households of Kirtipur. The drinking water supply system is very traditional and unscientific. Therefore, the problem of water supply has remained the same and people are facing acute problems of water. The KUKL, Kirtipur Branch has not yet stud-

ied the growth of settlements in Kirtipur. Therefore, first they need to know about the number of population in those settlements for supplying sufficient quantity of water. Otherwise, they will not be able to distribute water properly and always the problems remain the same.

6.8 Deficit of Drinking Water

In every part of the world today, drinking water is scarcity is growing very rapidly day by day. Nepal is also suffering that situation. So in every part of the country, the water is deficit. The demand for water is very high day by day and its supply is lessening every day. If the KUKL, Kirtipur Branch does not manage the drinking water supply systematically, the water crises will be increasing. They have to first know about the number of residents of each settlement or wards as well as the numbers of water connections. Then, they have to supply the water properly, systematically and scientifically with justice for lessening water deficit. There is 35,22,700 L water deficit per day in Kirtipur municipality.

6.9 Potential Water Resources for Kirtipur

There are many potential water resources near separate ward boundaries of Kirtipur municipality. These water resources are found in neighbouring VDCs like Chalnakhel, Machhegaon, and Matatirtha. A huge amount of water wasted in these localities. If the available water resources are well-managed and utilized properly, the water will be sufficient to resolve the problem of water crisis.

6.10 Plan and Policy

Some unpublished reports show that two billion people in the world are without clean water and sanitation. In the worst water feminized countries, people live on just two gallon of water a day, which is far below the 13.2 gallon stipulated by the UN as the absolute minimum for water needs. In about 20 years time, average water supply per person around the globe is likely to be one third smaller than it is now.

Agriculture uses more than 70% of global water and industry about 20% much of it is wasted. Drinking water is the basic minimum need of all living and human beings and provision of conventional safe, clean and adequate drinking water is the declared commitment of the government of Nepal. Population growth, rapid urbanization and industrialization are imposing rapidly growing demand of water supply and it pressurizes the government for the development of the water resources. The growing imbalance between demand and supply has brought various problems.

It has caused the shortage of drinking water and environmental degradation. Most people expect that water supply should be provided free of cost as social service, because they argue that water is a free gift of nature. Traditionally, in Nepal water supply has also been considered as social service and it is taken to be the obligation of the government or those in power to supply water very cheaply and if necessary even free.

Most of the projects mainly are focused on the installation of drinking water supply infrastructure. However, the INGOs and NGO-installed projects have package programs, which include training on agriculture and small income generating activities. Moreover, the INGO-installed DWS projects have included Non-Formal Education (NFE) programme during the construction period. Both INGOs and NGOs are being involved to deliver safe drinking water and sanitation in both urban and rural areas.

These NGOs and INGOs have been playing an effective role in the drinking water supply and sanitation sector through the implementation of water supplies projects which are usually integrative in nature and incorporate the high level of people's participation. The most active providers of services in WECS (Water and Environmental Sanitation Sector) are the Department of Water Supply and Sewerage (DWSS), Local Authorities (DDCs and VDCs), External Support Agencies (ESAs), Non-Governmental Organization (NGOs), CBOs and users' committees.

The government has introduced the Water Resource Act 1992, with the following main features: proper utilization of water resource-

es; and guidelines and instructions for the use of water resources to minimize the negative impacts on the environment. According to the Act, all water user committees should be registered with their respective district administration to legalize their action (B.W. 2000).

In order to ensure sustainability and certainty of projects and services, the concept of community management rural and semi-urban projects were put forward to enhance the concept of people's participation. Similarly, for ensuring and promoting the concept of community management, a provision of 20% contribution of the cost of execution of the project by the community has been made. However, in the case of backward class and targeted groups of people, the policy to contribute only 10% of the costs by community has been adopted.

Faculty extension programmes aimed at promotion public awareness towards sanitation are in operation as an integral part of drinking water projects. Against the target to complete 13 projects under development of water in the bygone Fiscal Year (2006/07) that would provide service to 123 thousand people, only 10 projects had been completed and the overall progress was recorded at 78% (Economic Survey, 2006/07: B.W. 2000). In the Tenth Plan (2002-2006), it was taken strategy in rural drinking water project on the basis of community needs and demands the project undertaken with the involvement of user community for maximum utilization of locally available resources and means. Moreover, it was given emphasis on the conservation of local resources and operating rural drinking water projects through the consumer committees and NGOs (Tenth Plan 2002-2007), and such institutions has also been given emphasis.

Summary, Conclusion and Recommendations

7.1 Summary

Indigenous people(s) play a significant role in management and sustainability of water resources. Their knowledge is an integral part of humanity's heritage and cultural diversity. Most of the water resources are available in Kirtipur where the indigenous Newar settlements are concentrated and very few water resources were discovered in other settlements other than Newar. This also proves that the Newar settlements are very ancient ones and they had made various water resources in Kirtipur.

Natural Resources Management means appropriation, distribution, utilization, and conservation of natural resources and the legitimate way of controlling them. From the beginning of human civilization, indigenous peoples have been managing the natural resources including water all over the world. Water is a mobile resource—it falls from the clouds, seeps into the soil, flows through aquifers, runs along stream courses, and eventually returns to the clouds. This natural cycle is the basis of all life support system and people extract resources from this system and used in economic term. Water is “managed” in different ways: it may be harvested, extracted from the ground, diverted, transported, and stored. This makes it different from all other natural resources. However, each form of man-

agement that interferes with the natural cycle exacts price, not just in economic terms but in terms of environmental damage and greater health hazards. Our water resources, irregularly distributed in space and time, are under pressure due to major population change and increased demand all over the world.

The indigenous Newar people used to manage the water resources in their surroundings from the beginning of human civilization in Kirtipur (now municipality). They have traditional knowledge system in water recharge as well as management system and they have kept the sufficient water resources till now but the modern developmental works displaced those systems and the migrants didn't follow those system then all the resources became worse. Therefore, the residents in Kirtipur municipality are facing water crises day by day. There are altogether 90 water resources such as well, dug-well, pond, river, Stone Spout, spring, lake, deep tube well, rain water harvesting, and reservoir in the study area.

Distributions of water resources are not equal in all parts of Kirtipur. Ward No. 2 has largest number (13) of water resources and ward No. 19 has only one water resource which lies in the western lowland of Kirtipur municipality. There are 3 main rivers i.e. Bagmati, Balkhu and Boshan and other rivulets flow in most of the wards. There are 17 reservoirs in different parts of the municipality for drinking water supply. The water connection is available in all the settlements and the supply duration and time is different in the day and week.

Drinking water connections at any rate are not sufficient for the daily activities of the local people in Kirtipur. So they are using water from other sources which are located in the nearest area. Water resources have been used for different activities in Kirtipur. Most of the water resources are used in drinking, agricultural activities (mainly irrigation) and washing. Other uses are in making alcohol and beer, cleaning, bathing, toilet floss, dish wash, livestock, construction, household supply and purification for god.

Most of the water resources are managed by the indigenous Newar people and only the drinking water is distributed by the

KUKL Kirtipur Branch. Their management has been found very effective and sustainable. In their society, cultural norms and values play very important roles in water resource managements. Newar people from the beginning believe that water is also god (*Jal Devata*) so that they didn't dump garbage near the water resources. That is how they are managing water resources very well but the new generation are not completely adopting such norms and values therefore the water resources have been declining. Without water we cannot imagine our lives as well as other agricultural activities.

Our daily activities, industries, livestock, agricultural activities need plentiful water. Easily available drinking water for households reduces the time span for hunting water and contributes to engage them in other activities like income generation, which is the prime factor for improving family's living standard and human development. It helps in social as well as economic growth of the people. Thus the water resources contribute a great deal for economic prosperity.

7.2 Conclusion

Water is a renewable resource—rivers, lakes, springs, and other water sources are all periodically replenished by natural processes. However, this does not mean it is inexhaustible; on the contrary, water is a finite good. Moreover, water is a vulnerable element liable to be easily polluted, wasted or in other ways damaged, with long-term consequences for human livelihoods and the environment. Man-made water regimes should therefore be taken into account that the natural dynamics of water systems disturb the delicate balance between water and the ecosystem. What required is in other words, is a *new water consciousness* that recognises sustainable water schemes should be resource friendly, and that the water users should have sufficient knowledge and respect for the resource which is so vital for their lives.

The distribution system of water started from the beginning of human civilization in Kirtipur. Since then the people have relied on water resources. However, the encroachment of people has caused

shrinkage of water resources day by day. Some are destroyed till now. Water resources are the natural assets for the people and one cannot imagine life without water.

This is basically related to the necessity of water for household consumption, and other economic activities such as industries, hotel and restaurants, transportation and others. The piped-water supply is far below the need of the people. The gap between demand and supply is widening each year. The world including Nepal is facing a water crisis of the 21st century. The problem is multi-faceted as it involves not only the issue of water shortage but also those relating to wastage, pollution, flood and drought due to climate change which is related to inhumane treatment over nature.

Decentralized approaches to water resource management that focus on river basins are increasingly pursued even across borders. Exchanging information between countries that share river basins will yield both economic and environmental benefits.

It has become evident that—

- Changes in climate are affecting water availability,
- Pollution, water diversions and uncertainties about the abundance of water are threatening economic growth, environment, and health,
- Underground water is often being overexploited and polluted,
- To augment water supply, traditional techniques—such as rainwater collection— are now being supplemented by newer technologies like desalination and water reuse, and
- Political support is needed to improve information collection that can in turn enable better decision making about the management and use of water.

Water resource development is not an end in itself: it is a means to an end. The end is to alleviate poverty and improve quality of life while protecting crucial ecological services performed by ecosystems. Achieving water security is essential for sustainable development which could be possible only with a radical shift in thinking as well as practice and radically improved governance.

Like other natural resources, source reduction, reuse, recycling and regeneration policy could help the conservation of water resources. Water resources can be managed and conserved to a large extent by adopting the following strategies—

- By watershed management,
- By curbing the wastage (attitude change),
- by reducing waste through evaporation, leaks and other losses.
- by reducing irrigation losses.
- by wasting less water in industries.
- by wasting less water in home and business.
- by raising the water prices.
- By not over exploiting and destroying water resources knowingly or deliberately,
- By not discharging unacceptable quantities of any substance,
- By using water resources in a fair and equitable way,
- By ensuring that drinking water supplies are reliable and fair,
- By managing water in an integrated manner which incorporates the needs of the social communities as well as wider environment in general,
- By recycling and reusing water as much as possible,
- By appropriate waste water treatment, and
- By appropriate financial arrangement needed for water management.

The quality of water for drinking purposes has deteriorated because of the inadequacy of treatment plants, direct discharge of untreated sewage into the rivers and inefficient technical management of the piped-water distribution system. Also the quality of water in rivers, ponds and lakes in major urban areas is deteriorating rapidly. As a consequence of such unhygienic water quality condition, water-borne diseases such as diarrhoea, dysentery and gastro-intertritis occur often. These diseases are prevalent in both urban and rural areas throughout the developing nations.

Nepal is a country, where people have facing several problems including infrastructures such as transportation, communication, electrification, health and pure drinking water. One of the many causes of lacking infrastructures is the lack of policy to hand-over responsibilities to the local communities. Most of the government-owned programmes have failed because of the lack of 'We' or 'Our' feeling of the local communities. Therefore, the local community-managed water resources has been found very effective especially in management, maintenance, waste less mobilization of available resources, distribution of benefit sharing, meaningful participation of local people, 'our' feeling of the local people etc are some major factors.

The study has found some clues that local community-managed water resources and supply system will improve the distribution system, reduces the cost of construction, improves the water quality because of the care of local people, reduces the burden of government etc. As a whole, it improves health and hygiene of the consumers, which is a great benefit of life and gainful from economic perspective too. Thus, the local community-managed drinking water supply system is effective and is also alternative option for drinking water management in Nepal.

7.3 Recommendations

Natural resources of any sort including water resources should be managed and maintained in a proper way for its sustainable use. Therefore, water resources should also be managed and maintained from time to time, otherwise its sources is decreased. Dumping the waste materials in or near the water resources are wrong practices. Water resources should be kept clean and non-polluted. It should always be kept in good conditions for its good quality. In Kirtipur, most of the water resources are disappearing gradually. Construction of water collection tanks or reservoirs is very urgent for collecting the overflowing water from every resource for future use. The following recommendations can be helpful for sustainable use of water resources to be adopted by responsible and concerned organizations.

The indigenous knowledge or techniques of water resources management were very effective in the past and still relevant presently. Therefore, such indigenous techniques should be adopted for sustainable management of water resources.

- Indigenous people have significant knowledge and skills to offer and responsibilities to fulfil in the protection of natural resources including water. Therefore, their participation in such efforts can contribute massively.
- Understanding, learning, respecting and applying Indigenous knowledge systems including Indigenous people in decision-making in natural resource management is key to reconciliation.
- Greater involvement of Indigenous people(s) in NRM will help increase Indigenous employment and improve Indigenous educational achievement for sustainable use and management of natural resources.
- Indigenous communities should be strengthened through their engagement in NRM.
- Municipality should develop the water resources conservation projects and programmes.
- Municipality should share the Newar indigenous knowledge to the rest of people's communities for water resources conservation and management.
- The water resources should be protected from the waste and other unwanted solid materials by constructing wall boundary. The KUKL should manage the other water sources and provide their water in nominal rate to the people.
- Municipality should allocate the budget to maintenance the water resources.
- Motivate the people about water resources and its management.
- Public awareness is needed in order to mobilize effective support for sustainable water management and induce the changes in behaviour and action required to achieve the

goal. Additionally, public awareness and subsequent pressure for actions might be vital in fostering the political will to act.

- People have also utilized the water resources in drinking, therefore the government should give authority to the local community to manage water resources and drinking water supply system. It was found to be very effective in terms of resource mobilization, motivation, construction, maintenance, distribution, participation etc. Therefore, it reduces the cost of construction. Moreover, it improves the quality of drinking water and further improves health and hygiene of the consumers. Therefore, it is recommended to adopt by other local/indigenous communities of the nation and local areas should be developed in short periods.
- The Municipality should have a long term vision of developmental plans and programmes and should study the positive impacts of water resources management.

Observation Sheet

S.N.

Date:

Locality Name: Ward No.

Types of Source:

GPS Location:E, Height:M

Established Date:

Condition: () Constant, () Declining, () Worst, () Renovate

Source Managed by: () Local Committee, () Drinking Water Supply Ltd.,

() Users' Group, () Clubs, () Private

Surrounding of the sources: () Sewerage, () Dumping site,

() Greenery (Wildering), () Open defecation, () Road,

() Boundary wall, () Settlements

Source & Maintenance Periods:

Repairs: () Yearly, () Half-yearly, () Occasion (Specify)

Occasion remarks

Utilization: () Drinking, () Washing Cloths, () Bathing, () Toilet,

() Dish Wash, () Cleaning, () Livestock, () Agricultural Field,

() Tanker Supply, () Construction, () Others (Specify)

Spring Level (Well): Hm, W m, Lm, Dm

V m³Size: Wm, Lm, Aream²

Water Quality Test: () Palatable, Remarks

Annex-II

Questionnaire for Users

Name: Ward No.

Address:

Water Connection: () Y, () N, Distance of the sources:

Time duration:

Sources and its purpose for daily life?

	Piped Line	Well	Dug Well	Stone Spout	River	Pond	Lake
Drinking							
Washing Cloths							
Bathing							
Toilet/Cleaning							
Livestock							

How is the facility of water in this area?

() Sufficient () Scarcity If Public, no. of Household

Does the water supplied from Nepal Water Supply Corporation is adequate for daily life?

() Yes () No

If yes, why

If No, why

How is the quality of Water Supplied from Nepal Water Supply Corporation?

() Good () Acceptable () Poor

How many hours a day do Nepal Water Supply Corporation provide water?

() 1/2 hrs () 1 hrs () 2 hrs () Alternative days () Regular

How many quantity of water in the supply period.

Days	No. of Gargies	20 Liters/ Gargies	Average Liters/day
1			
2			
3			
4			
5			
6			
7			

Do you face any kind of social problems (conflicts) in water sources use?

.....

Do you have any kind of health problems when you are using water from different sources?

.....

How many Rupees do pay for water bill in a month for uses of water connection?

Rs.

Can you pay whenever DWC supply the water 24 hours a day?

If yes, how much Rs, If No. How many hours per day and how much do you pay per month Rs.

Is the ground water in sufficient amount?

.....

What are the problems you are facing with the water availability?

.....

What is your suggestion for improvement?

.....

Questionnaire for Group Discussion

Name: Ward No.

Groups/Association:

Participant's Name:

- 1.
- 2.
- 3.
- 4.
- 5.

1. What are your major sources of water? How are Indigenous people (Newars) managing the water resources for using and its maintenance?

.....

.....

2. How did you find or locate the place of water resources in the past? What are the processes before water resources use?

.....

.....

3. What are the processes or time of the water resources maintenance or cleaning?

.....

.....

4. Why do the Newar people worship water as a God of water (Jal)? Give Reasons.

.....

.....

5. What do you feel about the water resources in past and present and what will be its condition in the future? Tell me something about your experiences:

- a. water resources in the past
- b. water resources at present/reasons
- c. your prediction for the future

.....

.....

.....

6. Who do you think responsible for the poor condition of water resources?

.....

.....

7. What do you think are the causes for water resources being dried out at present?

.....

.....

8. Have you heard about the Climate (Environmental) Change effects in water resources?

.....

.....

Photographs of Water Resources in Kirtipur



Plate 1: Well, Ward No. 17



Plate 2: Stone Spout, Ward No. 17



Plate 3: Stone Spout, Ward No. 3



Plate 4: Tube Well, Ward No. 2



Plate 5: Stone Spout (Hiticha Pha), Ward No. 6



Plate 6: Dug Well, Ward No. 6



Plate 7: Rain Water Harvesting Tank, Ward No. 6



Plate 8: Stone Spout (Naayega Hiti), Ward No. 6

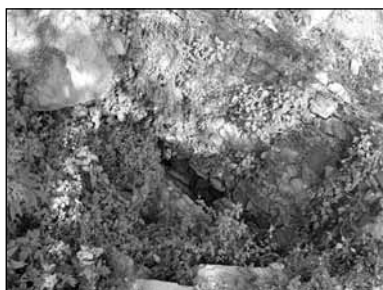


Plate 9: Well, Ward No. 2



Plate 10: Well, Ward No. 3



Plate 11: Well, Ward No. 3



Plate 12: Well, Ward No. 3



Plate 13: Well, Ward No. 2



Plate 14: Well, Ward No. 1



Plate 15: Stone Spout (Barkha Hiti), Ward No. 1



Plate 16: Stone Spout, Ward No. 2

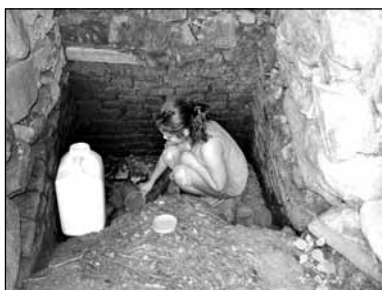


Plate 17: Well, Ward No. 2



Plate 18: Stone Spout, Ward No. 2



Plate 19: Well (Laxmi Gaa), Ward No. 2



Plate 20: Pond, Ward No. 2



Plate 21: Pond, Ward No. 2



Plate 22: Pond, Ward No. 6



Plate 23: Dug Well, Ward No. 6



Plate 24: Pond (Laabhaa Pukhu), Ward No. 5



Plate 25: Pond (Bhi Pukhu), Ward No. 5



Plate 26: Pond (Mabhi Pukhu), Ward No. 5



Plate 27: Spring, Ward No. 8



Plate 28: Well, Ward No. 8



Plate 29: Spring Tap, Ward No. 8



Plate 30: Spring Water Tank, Ward No. 8



Plate 31: Spring Pond (Drinking Water), Ward No. 7



Plate 32: Under Ground Spring & Reservoir, Ward No. 7



Plate 33: Reservoir, Ward No. 7



Plate 34: Spring Pond (Drinking Water), Ward No. 7



Plate 35: Taudaha Lake (Tarahn), Ward No. 15



Plate 36: Dug Well, Ward No. 6



Plate 37: Dug Well, Ward No. 6



Plate 38: Pound, Ward No. 2



Plate 39: Dug Well (Taacha Tun), Ward No. 5



Plate 40: Dug Well, Ward No. 5



Plate 41: Dug Well, Ward No. 5



Plate 42: Pond (Dye Pukhu), Ward No. 1



Plate 43: Stone Spout, Ward No. 17



Plate 44: Well (Taga Wapi), Ward No. 17



Plate 45: Pond, Ward No. 2



Plate 46: Well, Ward No. 14

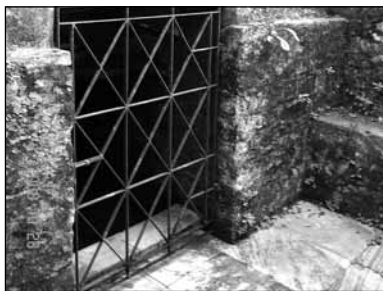


Plate 47: Well, Ward No. 14



Plate 48: Well, Ward No. 14



Plate 49: Well, Ward No. 14



Plate 50: Well Tank, Ward No. 13



Plate 51: Well, Ward No. 13



Plate 52: Stone Spout, Ward No. 13



Plate 53: Well, Ward No. 18



Plate 54: Reservoir, Ward No. 18



Plate 55: Reservoir, Ward No. 6



Plate 56: Deep Tube well & Reservoir, Ward No. 2



Plate 57: Reservoir (Unused), Ward No. 1



Plate 58: Well, Ward No. 4



Plate 59: Dug Well, Ward No. 16



Plate 60: Pond, (KhaaPukhu) Ward No. 16



Plate 61: Pond (disappeared), Ward No. 16



Plate 62: Pond (disappeared), Ward No. 16 (Saa Pukhu)



Plate 63: Dug Well, Ward No. 11



Plate 64: Dug Well, Ward No. 11



Plate 65: Pond, Ward No. 12



Plate 66: Pond, Ward No. 11



Plate 67: Pond, Ward No. 10



Plate 68: Dug Well, Ward No. 10



Plate 69: Dug Well, Ward No. 10



Plate 70: Dug Well, Ward No. 9



Plate 71: Dug Well, Ward No. 10



Plate 72: Dug Well, Ward No. 17



Plate 73: Spring (Naumule), Chalnakhel VDC



Plate 74: Reservoir, Ward No. 8



Plate 75: Unmanaged Spring Resource, Ward No. 8



Plate 76: Dug Well, Ward No. 19



Plate 77: Boshan River, Ward No. 7



Plate 78: Balkhu River (Mulkhushi), Ward No. 19



Plate 79: Dug Well (Taaja Tun), Ward No. 4



Plate 80: Well, Ward No. 2



Plate 81: Pound (Ga Pukhu), Ward No. 2



Plate 82: Spring (Jhawahiti), Ward No. 8/15



Plate 83: Spring, Ward No. 15



Plate 84: Stone Spout, Ward No. 2



Plate 85: Deep Tube well, Ward No. 8



Plate 86: Deep Tube well, Tanker Supply, Ward No. 14

References

- Agarwal, SK. 2003. 'Integrated Watershed Development: Technology,based Model for Rural Development', *Kurukshetra*, 51, 12: 49-57.
- Bhattarai, D. 2006. *An Impact Evaluation of the Community Drinking Water and Sanitation Project*. Kathmandu: IWMI.
- Brokensha, D. 1980. *Indigenous Knowledge Systems and Development*. Lanham: University Press of America.
- CBS. 2011. *National Census 2011*. Kathmandu: CBS, Government of Nepal.
- .2006. *District Profile of Kathmandu*. Kathmandu: CBS, Government of Nepal.
- .2005. *A Report on Water Survey of Kathmandu 2005*. Kathmandu: CBS, Government of Nepal.
- .2001. *National Census 2001*. Kathmandu: CBS, Government of Nepal.
- Chalise, S. R. and Gurung, D. 1993. *Natural Resources Management in a Mountain Environment*. Kathmandu: ICIMOD.
- Council, H. M. 1993. *Nepal Environmental Policy and Action Plan Integrating Environment and Development*. Kathmandu: His Majesty's Government of Nepal.
- Dixit, A. and Upadhyay, M. 2005. *Augmenting Ground Water in Kathmandu Valley: Challenges and Possibilities*. Kathmandu: Nepal Water Conservation Foundation.
- Gurung, H., 2000, Janajati Bikasko Jukti, [in Nepali] 'Idea for Development of Nationalities'. Kathmandu: Janajati Bikas-Samanwaya Kendra.
- Gurung, O. P. 1996. Customary Systems of Natural Resources Managment Among Tarami Magars of Western Nepal, Ph. D. dissertation, Cornell University, Ithaca.

- Hawley, A. H. 1950. *Human Ecology: A Theory of Community Structure*. New York: The Ronald Press Company.
- ICIMOD. 2007. *Sustainable Mountain Development in the Greater Himalayan Region*. Kathmandu: ICIMOD.
- . 2004. *Water Quality in South Asia: Issues and Status Workshop Proceeding*. Kathmandu: ICIMOD.
- . 2003. *GIS for Municipal Planning: A case study of Kirtipur Municipality*. Kathmandu: ICIMOD.
- Lekhakh, H. D. and Lekhak, B. 2003. *Natural Resource Conservation and Sustainable Development in Nepal*. Kathmandu: Kshitiz Publication.
- MUAN. 2006. *Municipal Database Analysis of Nepal*. Lalitpur: Municipal Association of Nepal (MUAN).
- Nepal, W. A. 2005. *Water Laws in Nepal*. Kathmandu: Water Aid Nepal.
- Nepal, G. O. 2007. *Unofficial Translation Three Year Interim Plan (007/08-2009/10)*. Kathmandu: National Planning Commission.
- NPC. 2007. *Unofficial Translation Three Year Interim Plan (007/08-2009/10)*. Kathmandu: National Planning Commission.
- . 2002. *Tenth Plan (2002-2007)*. Kathmandu: NPC, HMG.
- . 2064 BS. *Community Drinking Water and Sanitation*. Kathmandu: Community Based Water Supply and Sanitation Project, NPC.
- NSET. 2000. *Kirtipur Environmental Mapping Project*. Kathmandu: National Society for Earthquake Technology (NSET).
- Pant, D. 2002. Economic Analysis of Drinking Water Supply through people's Participation in Khurkot VDC of Parbat District of Nepal. MA thesis, Central Department of Economics, Tribhuvan University, Kirtipur.
- Pardhan, P.K. and Pradhan, B. (Eds.). 2006. *Environment and Natural Resources: Concepts, Method, Planning and Management*. Kathmandu: Quest Publication.
- Qadri, S. T. 2001. *Natural Resources Management and the Environment*, Asian Environment Outlook. The Philippines: Asian Development Bank.
- Ross, A. and Pickering, K. 2002. *Human Ecology: An Interdisciplinary Journal*, "The Politics of Reintegrating Australian Aboriginal and American Indian Indigenous Knowledge into Resource Management: The Dynamics of Resource Appropriation and Cultural Revival", 30, 2: 187-214.

- Sen, Chandra K., Pratap, Tej and Sharma, Prem N. 1997. *Farmer-Led Integrated Watershed Management*. , Kathmandu: ICIMOD.
- Sharma, S. 1994. 'Interface of Water, Religion & Development: Strains and Discord', *Water Nepal*, 4,1: 67-73.
- Shrestha, U. S. 1991. Land Use Changes in Kirtipur. MA thesis, Central Department of Geography, Tribhuvan University, Kirtipur.
- Upreti, B. R. 2002. *Management of Social and Natural Resource Conflict in Nepal: Realities and Alternatives*. New Delhi: Adroit Publisher.
- United Nations. 2009. *The Concept of Indigenous People*. New York: Department of Economic and Social Affairs, Division for Social Policy and Development, UN.
- Warren, D. M. 1992. Indigenous knowledge, bio-diversity conservation and development. Keynote address delivered at International Conference on Conservation of Biodiversity in Africa, Kenya.
- 1991. *Using indigenous knowledge in agricultural development. World Bank Discussion Paper No.127*. Washington DC: The World Bank.
- WECS. 2002. *Water Resources Strategy Nepal*. Kathmandu: Water and Energy Commission Secretariat (WECS).
- 2002. *Water Resources Strategy Nepal*. Kathmandu: Water and Energy commission Secretariat (WECS).
- www.cbs.gov.np. Accessed date August 2013
- www.google.com. Accessed date November 2013
- www.icimod.org.np. Accessed date January 2013
- www.mope.gov.np. Accessed date February 2013
- www.unesco.org/water. Accessed date June 2013
- www.wikipedia.org. Accessed date September 2013

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34. 2071 [AD 2014] *Dolakha Jillako Jatibhashabaigyaink Surbhekshen* (An Ethnolinguistic Survey of Dolakha District, Nepal) by EISuN Team, Research Grants supported by NFDIN.
33. 2071 [AD 2014] *Janayuddhama Adivasi Magarko Sahabhagita, Karan ra Parinam* (Adivasi Magar's Participation, Causes and Effects in Peoples' War) by Ram Thapa-Magar, Research Grants supported by NFDIN.
32. 2071 [AD 2014] *Nepalma Bahubhasha Sikshako Prabhavkari-ta, Pahunch ra Siksha Neeti* (Effectiveness, Access and Education Policy of Multilingual Education in Nepal) by Min Raj Chaudhary, Research Grants supported by NFDIN.
31. 2071 [AD 2014] *Adivasi Magarko Rajnitik Itihas* (Political Historical of the Indigenous Magar People) by Bhoj Bikram Budha-Magar, Research Grants supported by NFDIN.
30. 2071 [AD 2014] *Kiranti-Sampang Pahichanma Lokgeetko Bhumika* (The Role Folksongs in Kiranti-Sampang Identity) by Bhakta Sampang Rai, Research Grants supported by NFDIN.
29. 2070-1 [AD 2014] *Shingsa-homi Nariko Paramparagat Netritwo Pranali* (Traditional Leadership System of Shingsa-Lhomi Women) by Chingchippa Bhote Lama (Lhomi), Research Grants supported by NFDIN.
- 28.2070-71[AD 2014] *Newar Indigenous Knowledge of Water Re-*

- sources Management System in Kirtipur* by Sanu Raja Maharjan, Research Grants supported by NFDIN.
- 27.2070 [AD 2013] *Nepalka Adivasi Janajati Andolanko Ruprekha* (Historical Outline of Indigenous Nationalities' Movements in Nepal) by Lakpa Sherpa, Research Grants supported by NFDIN.
- 26.2070 [AD 2013] *Lhowa (Lhopa) Bhasha-Sahityako Ruprekha* (An Outline of Lhowa/Lhopa Language and Literature) by Shangbu Lhomi, Research Grants supported by NFDIN.
- 25.2070 [AD 2013] *Thakali Purkhyeuli Bhumi Thasang: Nak-sangkan tatha Vartaman Seema Vivadko Aitihasik Addhyan* (Thakali Ancestral Land Thasang: A Historical Study of its Mapping and Present Border Debates) by Associate Prof. Jyoti Bhattachan, Research Grants supported by NFDIN.
- 24.2070 [AD 2013] *Tamu Bhasha-Sahityako Addhyan* (A Study of Tamu (Gurung) Language and Literature) by Tej Tamu (Gurung), Research Grants supported by NFDIN.
- 23.2070 [AD 2013] *Adivasi Saundaryashatra: Kiranti-Kõits (Sunuwar)The:niko Ek Saidhantik Addhyan* (Indigenous Aesthetics: A Theoretical Study of Kiranti-Kõits (Sunuwar) The:ni) by Atit Mukhiya (Ishwor Kiran Sunuwar), Research Grants supported by NFDIN.
- 22.2070 [AD 2013] *Mukhiya System of Mustang: A Practice of Local Governance in Nepal* by Lal B Pun and Gyanendra Pun, Research Grants supported by NFDIN.
- 21.2069 [AD 2012-13] *Baram Jatiko Chinari* (An Ethnographic Profile of Baram), NFDIN.
- 20.2068 [AD 2012] *Kiranti-Kõits (Sunuwar) Jatiko Chinari* (An Ethnographic Profile of Kiranti-Kõits (Sunuwar)), NFDIN.
- 19.2068 [AD 2012] *Bote Jatiko Chinari* (An Ethnographic Profile of Bote), NFDIN.
- 18.2068 [AD 2012] *Uraũ Jatiko Chinari* (An Ethnographic Profile of Uraũ), NFDIN.
- 17.2068 [AD 2012] *Baragaũle Jatiko Chinari* (An Ethnographic Profile of Baragaũle), NFDIN.

- 16.2068 [AD 2012] *Gurung Jatiko Chinari* (An Ethnographic Profile of Gurung), NFDIN.
- 15.2068 [AD 2012] *Larke (Nupri) Jatiko Chinari* (An Ethnographic Profile of Larke), NFDIN.
- 14.2068 [AD 2012] *Tamang Jatiko Chinari* (An Ethnographic Profile of Tamang), NFDIN.
- 13.2068 [AD 2012] *Tingaula Thakali Jatiko Chinari* (An Ethnographic Profile of Tingaula Thakali), NFDIN.
- 12.2068 [AD 2012] *Dhimal Jatiko Chinari* (An Ethnographic Profile of Dhimal), NFDIN.
- 11.2068 [AD 2012] *Lepcha (Rong) Jatiko Chinari* (An Ethnographic Profile of Rong/Lepcha), NFDIN.
- 10.2068 [AD 2012] *Limbu (Yakthung) Jatiko Chinari* (An Ethnographic Profile of Limbu), NFDIN.
9. 2067 [AD 2011] *Yakkha Jatiko Chinari* (An Ethnographic Profile of Yakkha), NFDIN.
8. 2067 [AD 2011] *Magar Jatiko Chinari* (An Ethnographic Profile of Magar), NFDIN.
7. 2067 [AD 2011] *Majhi Jatiko Chinari* (An Ethnographic Profile of Majhi), NFDIN.
6. 2067 [AD 2011] *Rai Jatiko Chinari* (An Ethnographic Profile of Rai), NFDIN.
5. 2067 [AD 2011] *Tharu Jatiko Chinari* (An Ethnographic Profile of Tharu), NFDIN.
4. 2067 [AD 2010] *Marpha Thakali Jatiko Chinari* (An Ethnographic Profile of Marpha Thakali), NFDIN.
3. 2067 [AD 2010] *Newar Jatiko Chinari* (An Ethnographic Profile of Newar), NFDIN.
2. 2067 [AD 2010] *Sherpa Jatiko Chinari* (An Ethnographic Profile of Sherpa), NFDIN.
1. 2067 [AD 2010] *Chepeng Jatiko Chinari* (An Ethnographic Profile of Chepeng), NFDIN.

His published books

12. *Kiranti-Köits (Sunuwar) Remublemu: Rimatsema Hirsshi* [Kiranti-Köits Literature: A Journey of Identity] (2013) published by Research Institute for Kirātology. Pp. 175+VIII.
11. *Kiranti-Köits (Sunuwar) Jatiko Chinari* [An Ethnographic Profile of Kiranti-Köits] (2012) published by Köitsbu (Sunuwar Welfare Society) and National Foundation for Development of Indigenous Nationalities. Pp. 293+xxii.

10. *Adekha Phulka Geetharu: Samakaleen Nepali Kavita Sangalo* [Songs of the Invisible Flower: An Anthology of Contemporary Nepali Poetry] (2010) published by Research Institute for Kirātology. Pp. 41+iv.
9. *Matatik Phu:ke Kumsopikya: Kiranti-Kōitske Mimsble Khupsi* [Songs of the Invisible Flower: An Anthology of Contemporary Kiranti-Kōits Poetry] (2010) published by Research Institute for Kirātology. Pp. 76+xv.
8. *Contemporary Essays on Vanishing Ethnicity, Cultures and Languages of Nepal: A Focus on Kiranti-Kōits* (2009a) published by Research Institute for Kirātology. Pp. 322+xvii.
7. *Nepalko Adivasi Kiranti Jati Serophero: Wallo, Majhra Pallo Kirant* [The Sphere of Indigenous Kiranti People of Nepal: Near, Central and Far Kirant] (2009b) published by Research Institute for Kirātology. Pp. 246+xii.
6. *Indo-Nepal Kiranti Bhashaharu: Vigat, Samakaleen Pariveshra Bholika Chunautiharu* [Indo-Nepal Kiranti Languages: Past, Contemporary Dynamics and Future Challenges] (2008) published by Research Institute for Kirātology. Pp. 640+xviii.
5. *Eclectic Activity English: A Creative Course* (2007) LVI Support System Inc.
4. *Kiranti-Kōits-a The:si Khyōpat* [Elementary Reader of Kiranti-Sunuwar] (2004) published by Sikkim Sunuwar [Mukhia] Association Kōitsbu.
3. *Kiranti-Kōits Lo: Sessebdese* [Kiranti-Kōits Language Education] (2004) published by Sunuwar Welfare Society, Kōitsbu.
2. *Kiranti-Kōits Blesetheka* [Kiranti-Sunuwar Alphabet] (2003) published by Sikkim Sunuwar [Mukhia] Association Kōitsbu.
1. *Kiranti-Kōits-a The:si Tarando* [Elementary Grammar of Kiranti-Sunuwar] (2003) published by Sikkim Sunuwar [Mukhia] Kōitsbu.

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